# HADLEY'S QUADRANT.

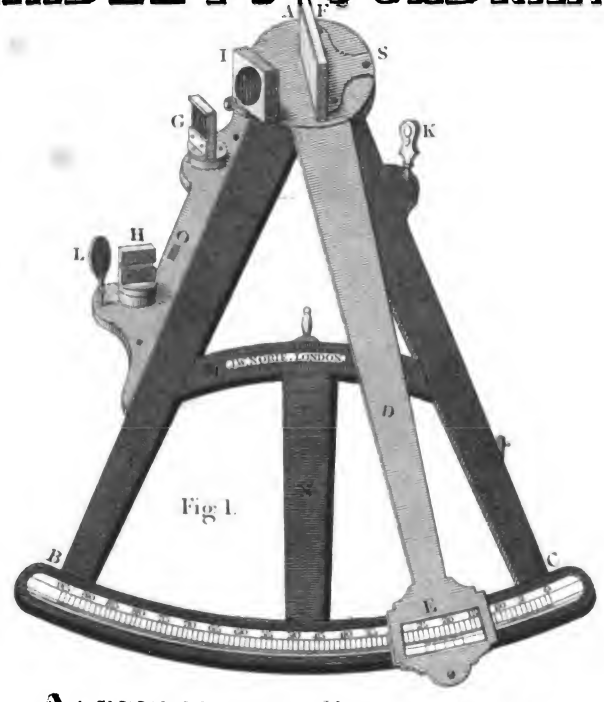


Fig 1.

# AZIMUTH COMPASS.

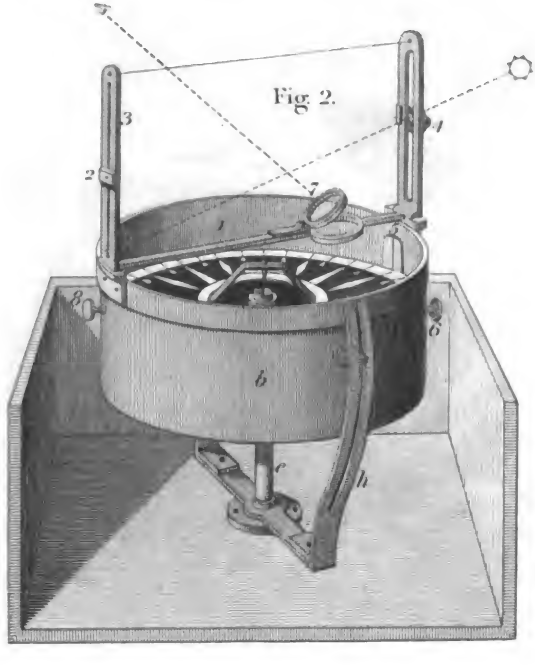


Fig. 2.

A

# COMPLETE EPITOME

OF

# Practical Navigation,

CONTAINING

ALL NECESSARY INSTRUCTION FOR KEEPING A SHIP'S RECKONING

## AT SEA:

WITH THE MOST APPROVED METHODS OF ASCERTAINING

**THE LATITUDE,**

BY MERIDIAN, SINGLE, OR DOUBLE ALTITUDES;

AND

**THE LONGITUDE,**

BY CHRONOMETERS, OR LUNAR OBSERVATIONS;

INCLUDING

**A Journal of a Voyage from London to Madeira,**

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TO WHICH IS ADDED

A CORRECT AND EXTENSIVE

## SET OF TABLES,

PRECEDED BY A COPIOUS EXPLANATION OF EACH TABLE.


## BY J. W. NORIE,

TEACHER OF NAVIGATION AND NAUTICAL ASTRONOMY.



Eleventh Edition,

*CONSIDERABLY AUGMENTED AND IMPROVED;*

AND ADAPTED TO THE **NEW NAUTICAL ALMANACS**, PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF THE ADMIRALTY.

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TO THE HONOURABLE

# THE COURT OF DIRECTORS

OF THE

# UNITED EAST INDIA COMPANY,

WHO

*SO LIBERALLY ENCOURAGE WHATEVER TENDS TO THE PROMOTION OF USEFUL KNOWLEDGE,*

THIS TREATISE ON

# PRACTICAL NAVIGATION

IS, BY PERMISSION,

AND WITH THE GREATEST RESPECT,

DEDICATED

*BY THEIR MOST OBEDIENT, HUMBLE SERVANT,*

JOHN WILLIAM NORIE.

# PREFACE.

HAVING been for several years past engaged in the instruction of persons designed for, or belonging to the Sea, I have frequently had occasion to lament that most of the existing Works on Practical Navigation, and particularly some that have been very generally circulated, are extremely erroneous, both in the instructive and tabular parts, and by no means calculated to answer all the purposes of the Mariner, Teacher, or Pupil.

With a view to remedy these defects, and to facilitate the acquirement of this most important Art, and further stimulated by the flattering reception of my former labours, I have ventured to exert my best abilities in composing the present Work; and although I do not mean to arrogate to myself any superior professional merit, yet I humbly apprehend that my long experience, and intimate connection with the subject, have enabled me, in some measure, to form a competent judgment of what is most requisite to assist the industrious Mariner in acquiring a knowledge of the practical part of Navigation.

In order to accomplish my intended purpose as effectually as possible, I have examined, with the greatest attention and caution, the various publications that have been written on Navigation; and, placing them in a comparative point of view, have, I trust, been thence enabled to avoid the errors, and to improve the merits of those who have preceded me in this branch of Science.

That nothing might be wanting to assist the student in his progress through the subject, I have commenced with a short Treatise on Decimal Arithmetic, the nature of which he will find very necessary to be understood in going through the various computations that follow. In Geometry such definitions and problems only are introduced as appear most essential. Plane Trigonometry, both right and oblique-angled, being the foundation of the Sailings, is treated of at considerable length. Next follows Geography, containing a description of the form and magnitude of the Earth, with its various real and imaginary divisions, and an explanation of the nature of Latitude and Longitude. An account is then given of the Instruments used for measuring a Ship's Way, with the manner of correcting their errors. This finishes the introductory part to Navigation.

We now proceed to the various Sailings, in which the examples are resolved by construction, calculation, inspection, and Gunter's Scale; then follows a description of Charts, with the methods of using and constructing them. The art of surveying Coasts and Harbours, being very essential to those who visit unknown parts, is treated in a manner which it is hoped will make its acquisition and practice perfectly easy.

We come next to the application of Astronomy to Navigation; and here I have thought proper to give a short but comprehensive view of the Solar System, where the Earth is considered as a planet; and have then described the various imaginary circles of the Sphere. The nature of Parallax, Refraction, &c. is explained under this head. The theory of the Winds and Tides, with the methods of finding the Time of High Water, follow next in order.

The most approved methods of ascertaining the Latitude and Longitude at Sea by Celestial Observations, also the variation of the Compass by Amplitudes and Azimuths, are explained by proper rules and examples: there is also given a particular description, with the uses, of the various astronomical Instruments employed in taking the Observations. In this part of the Work I have given Mr. Douwes' rules for computing the Latitude by two Altitudes of the Sun, and four different methods of clearing the Distance; the last of which, invented by Captain Mendoza Rios, has the advantage of not requiring any distinction of cases. The method of finding the Longitude by a Timekeeper being now much practised, the necessary rules and examples are introduced for that purpose.

The learner is next led into the Rules for keeping a Journal at Sea, wherein are exhibited the methods of correcting the Courses for Leeway, Variation, &c. with general Rules for working a Day's Work; and the whole is illustrated by separate Days' Works, and further, by a Journal kept from England to Madeira.

With respect to the Tables in this Work, I have only to observe here, that they are published under the title of "*Nautical Tables*;" have been very generally adopted by the Officers in the Navy, and in the Honourable East India Company's Service; and have received the approbation of Navigators in general.

---

Ten Editions of this Treatise having been submitted to the candid judgment of a discerning Public, and met with a most flattering reception, I have been induced, both from a sense of gratitude, and an earnest desire of rendering the Work still more useful, to revise the whole with the greatest care and

circumspection. In doing this, I have made considerable additions, particularly on the subject of determining the Latitude and Longitude by Celestial Observations. In the Rules for correcting the apparent Distance for the effect of Parallax and Refraction, I have introduced a fifth method, which, with the assistance of a set of Linear Tables, invented and published by me, is rendered one of the easiest and shortest that have been proposed. I have also treated at considerable length on the use and management of Chronometers, with the method of examining and comparing their rates; have added several new Tables, and corrected the Latitudes and Longitudes of places according to the most modern and best authenticated observations: in short, having made every alteration and improvement that long experience and unremitted attention have suggested, I trust that the present Edition will merit a continuance of that approbation, which the Work has always hitherto experienced from a liberal and enlightened Public.

J. W. NORIE.

NAVAL ACADEMY, LEADENHALL STREET.

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## ERRATA.

Page 51, 14th line from the bottom, *for* 25° 24′ *read* 26° 49′, and *for* 108° 16′ *read* 106° 51′.
108, 15th line from the top, *for* N. 86° 30′ W. *read* N. 86° 31′ W.
" 16th line from the top, *for* 556. 9 *read* 559. 6.
168 to 171, where Table LIII. occurs, *read* Table LVII.
186, last line but one, *for* Table LIV. *read* Table LV.
188, last line but one, *for* 0° 3′ 28″ *read* 0° 3′ 38″.
" last line, *for* latitude 34° 2′ 58″, *read* latitude 34° 3′ 8″.
190, in Example II. *for* 9h. 30m., *read* 9h. 40m.
" in the Work, *for* 9h. 30m., *read* 9h. 40m.
" Ditto, *for* 29h. 21m., *read* 29h. 31m.
211, in Example III. *for* W. 6° 15′ S. *read* W. 4° 17′ S.
223, third line from the bottom, *for* new *read* mere.
247, last line, *for* 21 5′ *read* 21′ 5″.

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Page 76, opposite the Star Betelguese, *for* Ann. Var. — 1. 21 *read* + 1. 21.
210, opposite 7m. and under 0s. *for* 88269 *read* 88259.
" opposite 7m. and under 5s. *for* 88278 *read* 88268.
274 to 277, at the top, *for* the Sun or a Star, *read* a Celestial Object.
288, fourth line from the top, *for* logarithm *read* logarithms.

# NAVIGATION.

## INTRODUCTION.

NAVIGATION is that Art which instructs the mariner in what manner to conduct a ship through the wide and trackless ocean, from one part to another, with the greatest safety, and in the shortest time possible.

It is difficult to trace the origin of this most important Art, to which a diversity of events might have given rise; but, in all probability, it owes its birth to necessity, the parent of almost every human invention. The Sea Coasts, in many places, are full of islands at no great distance from the Continent: curiosity would naturally inspire men with an inclination to visit these islands, and consequently prompt them to devise means by which they might convey themselves from one place to another on the surface of the water; and as this passage did not appear either very long or very dangerous, they determined to attempt it: success in one of these efforts might encourage a second; and we are informed by Pliny, that anciently they sailed only among the islands, and passed over on rafts or logs of wood.

As Science and Commerce advanced, the machines first used would of course give way to others of more improved structure and greater convenience; and hence the invention of boats and vessels of various denominations, better adapted to the nature and extent of the voyages undertaken. In process of time, men being convinced by experience that vessels designed for navigating the seas, ought to be of a different construction from those intended for rivers, they would make it their study to give such a form and solidity to ships designed for the sea, as would enable them to resist the impetuosity of its waves.

The action of the wind, of which the effects are so sensible and so frequent, might soon suggest the use of sails; but the manner of adjusting and managing them was more difficult, and would not be so soon discovered: this, in fact, appears to have been the last part of the general construction of vessels that was found out; and this opinion seems confirmed by the practice of savages in the South Seas and other parts, who generally use only oars or paddles, but seldom have sails: such must have been the case in the first ages.

The confusion and uncertainty in which the first navigators must have found themselves, when either prompted by their enterprising spirit to visit remote parts, or driven by the violence of storms out of the sight of land,

would naturally induce them to study some method of finding where they were in such circumstances: they might soon be sensible that the inspection of the heavenly bodies was the only means that could afford them just conclusions in this respect; in this manner, probably, Astronomy came to be applied to Navigation.

However, leaving these speculations respecting the rise and progress of Navigation, history informs us that the Phœnicians were the first who attained any great proficiency in the Art, especially those of Tyre, their capital, who sent out various colonies, the principal of which settled on the Coast of Africa, and built Carthage, a city that in time rivalled Tyre itself. After the destruction of Tyre by Alexander the Great, the Art was transferred by the conqueror to Alexandria, a new city in Egypt, intended by him for the capital of the world; thence diffusing itself, in process of time, throughout the whole of the Mediterranean, and parts adjacent.

But Navigation at that time consisted of little more than the management of small barks, which crept along the shore, seldom losing sight of the land: it was not till the discovery of the compass that mariners ventured to explore the vast ocean, and sought, as it were, for other worlds, at an immense distance: since that period, the Art has been continually receiving fresh improvements from the efforts of learned and ingenious men, both in respect to the construction of vessels, and the methods of working and conducting them; so that, at the present time, a voyage to the remotest part of the globe may be performed in the short space of a few months.

Navigation may be divided into two branches: viz. *Seamanship*, comprehending the method of managing a vessel by disposing her sails, rudder, &c. so that she may move in any assigned course or direction the wind or weather will permit; and *Navigation Proper* (the part we intend principally to treat of in the present Work), which comprehends those methods by which a mariner determines at any time the situation of his vessel, the course she is to be steered, and the distance she has to run, to gain her intended port: hence the requisites for a mariner, in order to understand this branch of the Nautical Art, are, a competent knowledge of the figure and magnitude of the earth, with the various imaginary circles drawn upon it, so as to be able to ascertain the distance and situation of places with respect to each other; the method of finding the ship's latitude and longitude, either by her course and distance run, or by astronomical observations; the use of various instruments, as the log, compass, half-minute glass, quadrant, sextant, &c.; the different allowances necessary to be made in estimating a ship's way, as for leeway, variation, and currents; the method of finding the time of high water at any place; the use of charts, both Plane and Mercator's, with the method of constructing them; all of which particulars, depending upon mathematical and astronomical principles, with whatever relates to the practical navigator, we shall endeavour, in the following sheets, to explain and illustrate in such a manner as to render every part as clear, concise, and methodical as an Art, embracing such a variety of subjects, will possibly admit.

# DECIMAL ARITHMETIC.

**WHEN** any quantity is considered as constituting a whole, it is called an *integer;* and when an integer is supposed to be divided into a certain number of equal parts, any number of these parts, considered in their relation to the whole, is called a *fraction*, which is expressed by two numbers placed one above another with a line between them; the lower of these, called the *denominator*, denotes the number of parts into which the integer or whole is divided, and the upper, called the *numerator*, expresses how many of these parts are contained in the fraction: for instance, suppose a foot divided into 6 equal parts, and 4 of those parts were to be considered as a fraction of the whole; it would be written in numbers thus $\frac{4}{6}$, where the figure under the line shews that the foot is divided into 6 parts, and the 4 above the line denotes the number of those parts contained in the fraction.

Fractions, whose denominators are 10, 100, 1000, &c. that is, a unit with ciphers annexed to it, are called *Decimal Fractions;* but with any other denominators they are called *Vulgar Fractions.*

As the denominators of decimal fractions are always one of the numbers 10, 100, 1000, &c., it is most convenient to write down the numerators only, placing before them a mark called a *decimal point*, to distinguish them from whole numbers; for the value of each place of figures will be known in decimals, as well as in whole numbers, by their distance from the decimal point; which will appear by the following Table, where the figures to the left-hand of the decimal point are considered as whole numbers, and those to the right, decimals.

| WHOLE NUMBERS. | | | | | | | | DECIMALS. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 6 | 4 | 5 | 6 | 8 | 7 | . | 2 | 4 | 6 | 8 | 9 | 3 | |
| Hund. of Thousands. | Tens of Thousands. | Thousands. | Hundreds. | Tens. | Units. | | | Tenths. | Hundredths. | Thousandths. | Ten Thousandths. | Hund. Thousandths. | Millionths. | |
| Millions. | | | | | | | | | | | | | | |

Thus . 2 or $\frac{2}{10}$ is read two-tenths, and 87. 24, eighty-seven and twenty-four hundredths; the latter of these is called a *mixed number*, because it consists of a fraction and an integral or whole number.

In setting down a decimal fraction without its denominator, the numerator must consist of as many places as there are ciphers in the denominator;

and if it have not so many figures, the defect must be supplied by setting ciphers before them; thus, $\frac{3}{10}$ is .3, and $\frac{16}{100}$ is .16, and $\frac{14}{1000}$ is .014, and $\frac{5}{1000}$ is .005, &c.

Hence it appears, that as ciphers on the right-hand of whole numbers *increase* their value decimally, or in a tenfold proportion, as 5, 50, 500, &c., so when set on the left of decimal fractions, they *decrease* the value decimally, or in a tenfold proportion, as .5, .05, .005, &c. But ciphers set on the other sides of these numbers make no alteration in their value, either of increase or decrease; so 5, or 05, or 005, &c. are all of the same value, as are .5, or .50, or .500, &c.; for in the latter case it is evident that the numerator increases in the same proportion as the denominator.

Having thus briefly explained the nature of fractions, we shall now proceed to lay down the Rules necessary to be understood in the practice of Navigation, giving a few examples to each by way of illustration.

## ADDITION AND SUBTRACTION.

RULE. These are performed exactly the same as in whole numbers, observing always to place the decimal points in a line, so that figures of the same denomination may range under each other.

EXAMPLES IN ADDITION.

| | | | |
|---|---|---|---|
| .5 | 53.2 | 65. | 720.1464 |
| .75 | 79.46 | 246.3 | 39. |
| .253 | 2.304 | 19.24 | 7.246 |
| .582 | 127.4 | 121.46 | 259.1703 |
| 2.085 | 262.364 | 452.00 | 1025.5627 |

EXAMPLES IN SUBTRACTION.

| | | | |
|---|---|---|---|
| .75 | 246.25 | 174. | 176.014 |
| .5 | 19.5 | 2.561 | 29.008 |
| .25 | 226.75 | 171.439 | 147.006 |

## MULTIPLICATION.

RULE. Multiply the given numbers together as if they were whole numbers, and point off as many decimals in the product, counting from the right-hand, as there are decimals in the multiplicand and multiplier together. When it happens that there are not so many figures in the product as there must be decimals, supply the defect by prefixing ciphers on the left-hand.

EXAMPLES.

| | | |
|---|---|---|
| .25 Multiplicand. | 3.275 | .2376 |
| .42 Multiplier. | 29.5 | .0062 |
| 50 | 16375 | 4752 |
| 100 | 29475 | 14256 |
| | 6550 | |
| .1050 Product. | 96.6125 | .00147312 |

## DIVISION.

RULE. Divide as in whole numbers, observing that the divisor and quotient are to contain together as many decimal figures as there are in the dividend; if therefore the dividend have just as many places of decimals as the divisor, the quotient will be a whole number without any decimal figures. If there be more places of decimals in the dividend than in the divisor, point off as many figures in the quotient as there are decimals, in the dividend more than in the divisor, a want of places in the quotient being supplied with ciphers on the left-hand; and if there be more places of decimals in the divisor than in the dividend, add ciphers to the dividend to make as many places of decimals as in the divisor; then the quotient will be a whole number, without decimals.

When, after the division, there is a remainder, ciphers may be added to the dividend, and the operation continued as before, until either there be no remainder, or a sufficient degree of exactness be obtained in the quotient.

EXAMPLES.

| Divisor. | Dividend. | Quotient. |
|---|---|---|
| 6.5 ) | 7234.5 | ( 1113. |
| | 65 | |
| | 73 | |
| | 65 | |
| | 84 | |
| | 65 | |
| | 195 | |
| | 195 | |

| Divisor. | Dividend. | Quotient. |
|---|---|---|
| 12.5 ) | .45695 | ( .0365 |
| | 375 | |
| | 819 | |
| | 750 | |
| | 695 | |
| | 625 | |
| | 70 | |

| Divisor. | Dividend. | Quotient. |
|---|---|---|
| .423 ) | 476.520 | ( 1126 |
| | 423 | |
| | 535 | |
| | 423 | |
| | 1122 | |
| | 846 | |
| | 2760 | |
| | 2538 | |
| | 222 | |

| Divisor. | Dividend. | Quotient. |
|---|---|---|
| 96 ) | 2.30000 | (.02395 |
| | 1 92 | |
| | 380 | |
| | 288 | |
| | 920 | |
| | 864 | |
| | 560 | |
| | 480 | |
| | 80, &c. | |

## REDUCTION.

*To reduce a Vulgar Fraction to a Decimal of the same Value.*

Rule. Add ciphers at pleasure to the numerator, and divide by the denominator; the quotient will be the decimal fraction required.

EXAMPLES.

Reduce $\frac{5}{8}$ of a mile to a decimal fraction.

6) 3.0

.5 or $\frac{5}{10}$

which is a decimal of the same value with the proposed vulgar fraction $\frac{5}{8}$.

Reduce $\frac{23}{60}$ of a degree to a decimal fraction.

60 ) 23.000 (.383 or $\frac{383}{1000}$ nearly.
180

500
480

200
180

20, &c.

Every quantity may be considered as a fraction of a larger of the same kind: as a league the $\frac{1}{20}$ of a degree; an inch, the $\frac{1}{12}$ of a foot, &c.; and therefore may be reduced to a decimal fraction, as in the following

EXAMPLES.

What decimal part of a foot is 9 inches?

12 ) 9.00

.75 or $\frac{75}{100}$,

which is equal to $\frac{9}{12}$ of a foot.

What is the decimal value of 15 miles, considered as a fraction of a degree?

60) 15.00 (.25 or $\frac{25}{100}$.
120

300
300

When the given quantity consists of several denominations, reduce them to the lowest, as in common Arithmetic; likewise reduce the integer to the same denomination; then proceed as before.

EXAMPLES.

Reduce 1 foot 6 inches to the decimal of a yard.

| Ft. | In. | Ft. |
|---|---|---|
| 1 | 6 | 3 = 1 Yard. |
| 12 | | 12 |
| 18 Numerator. | | 36 Denominator. |

36) 18.0 (.5 Answer.
180

Reduce 21 minutes 54 seconds to the decimal of a degree.

| Min. | Sec. | Sec. |
|---|---|---|
| | 21 | 54 = 1314 Numerator. |
| 1 deg. or 60 | | 0 = 3600 Denominat. |

3600) 1314.000 (.365 Answer.
10800

23400
21600

18000
18000

*To find the Value of a Decimal Fraction in Money, Weight, Measure, &c.*

Rule. Multiply the decimal by the number of parts of the next inferior denomination contained in the integer; pointing off in the product as many places for decimals, to the right-hand, as the given decimal consists of, and those to the left-hand will be an integer number: then multiply the remaining decimals by the number of parts contained in the next inferior denomination, and point off the decimals as before. Proceed thus till it be brought to the lowest denomination.

EXAMPLES.

What is the value of .875 of a pound sterling?

.875
20

Shillings 17.500
12

Pence 6.000

Answer, 17s. 6d.

What is the value of .42 of a degree?*

.42
60

Minutes 25.20
60

Seconds 12.00

Answer, 25 minutes 12 seconds.

* When tenths of a degree or minute are to be reduced into minutes or seconds, it may be expeditiously done by multiplying the tenths by 6, and the product will give the minutes or seconds required: for example, .5 of a degree multiplied by 6 gives 30 minutes, and .9 of a minute, 54 seconds. On the contrary, to reduce minutes and seconds to tenths of a degree or minute, divide them by 6.

What is the value of . 16669 of a yard?

.16669
3

Feet .50007
12

Inches 6.00084

Answer, 6 inches nearly.

What is the value of . 259 of a league?

.259
3

Miles .777
8

Furlongs 6.216
220

Yards 47.520

Answer, 6 furlongs 47. 52 yards.

## RULE OF THREE.

When three numbers are given to find a fourth proportional, the method by which it is performed is called the RULE OF THREE, and is the same in decimals as in common Arithmetic: *vix.* by multiplying the second and third terms together, and dividing the product by the first, when the quotient will give the fourth term, or proportional number required, of the same kind with the second. If the given numbers consist of several denominations, they are to be reduced to decimals by the preceding Rules.

### EXAMPLES.

If a ship sail 49. 5 miles in 8 hours, how many miles will she run in 24 hours, supposing her to go at the same rate?

Hours. Miles. Hours.
8 : 49.5 :: 24
24

1980
990

8)1188.0

Miles 148.5 Answer.

Suppose a watch or time-piece gain 14 seconds in 5 days 6 hours, how much will it gain in 17 days 15 hours?

6 hours = .25 of a day.
15 hours = .625 of a day.

Days. Seconds. Days.
5.25 : 14 :: 17.625
17.625

70500
17625

Sec.
5.25)246.750(47 Answer.
2100

3675
3675

# LOGARITHMICAL ARITHMETIC.

LOGARITHMS* are a series of artificial numbers, originally invented by John Napier, Baron of Merchiston in Scotland, and afterwards improved by Mr. Briggs, in order to expedite long calculations in arithmetic; for by using these numbers, the tedious operations of Multiplication and Division are avoided, and performed by Addition and Subtraction. This method of calculation is called *Logarithmical Arithmetic.*

## MULTIPLICATION.

RULE. Add together the logarithms of the two numbers to be multiplied (found in Table XXIV.) and their sum will be a logarithm, the natural number corresponding to which will be the product required: if either the multiplicand or multiplier, or both of them, should consist wholly of decimals, and the index of the sum exceed 10, reject the 10, and the remainder will be the index of the logarithm answering to the product.

EXAMPLES.

| | | | | | |
|---|---|---|---|---|---|
| Multiply | 25 | Log. 1.39794 | Multiply | 23.2 | Log. 1.365488 |
| by | 3 | Log. 0.47712 | by | .6 | Log. 9.778151 |
| Product | 75 | Log. 1.87506 | Product | 13.92 | Log. 1.143639 |
| Multiply | 3.71 | Log. 0.56937 | Multiply | .246 | Log. 9.390935 |
| by | 2.5 | Log. 0.39794 | by | .07 | Log. 8.845098 |
| Product | 9.275 | Log. 0.96731 | Product | .01722 | Log. 8.236033 |

## DIVISION.

RULE. From the logarithm of the dividend subtract the logarithm of the divisor, and the remainder will be a logarithm, whose corresponding number will be the quotient required. When the index of the divisor exceeds that of the dividend, borrow 10, and the remainder will be the index of the quotient.

* For the history, nature, and construction of Logarithms, see the Introduction to Dr. Hutton's Set of Mathematical Tables; and for the manner in which they are arranged, and are to be taken out in this Work, see the Explanation to Table XXIV.

EXAMPLES.

| | | | | | |
|---|---|---|---|---|---|
| Divide | 75 | Log. 1.87506 | Divide | 139.2 | Log. 2.143639 |
| by | 3 | Log. 0.47712 | by | 6 | Log. 0.778151 |
| Quotient | 25 | Log. 1.39794 | Quotient | 23.2 | Log. 1.365488 |
| Divide | 9.275 | Log. 0.96731 | Divide | .01722 | Log. 8.236033 |
| by | 2.5 | Log. 0.39794 | by | .07 | Log. 8.845098 |
| Quotient | 3.71 | Log. 0.56937 | Quotient | .246 | Log. 9.390935 |

## INVOLUTION.

INVOLUTION is the raising of powers from a given root. When a number is multiplied by itself, the product is called its 2d power, or *square*; when this product is multiplied by the given number, the last product is called its 3d power, or *cube*; and when the multiplication is again repeated, the 4th power, and so on. The 1st power, or number thus raised, is called the *root*, and the number of the power to which the given number is raised, the *index* of that power: hence, to raise or involve a number to a given power, multiply its logarithm by the index of the power to which it is to be raised, and the product will be the logarithm of the power sought.

When the given number is a decimal fraction, prefix as many ciphers, less one, as the index of the product wants of being 10 multiplied by the index of the power.

EXAMPLES.

| | | | | | |
|---|---|---|---|---|---|
| Required the square, or 2d power, of 15. | | | Required the square of .174. | | |
| Root 15 | Log. | 1.17609 | Root .174 | Log. | 9.240549 |
| Index..... | | 2 | Index..... | | 2 |
| Power 225 | Log. | 2.35218 | Power .030276 | Log. | 18.481098 |
| Required the cube, or 3d power, of 2.5. | | | Required the 5th power of .2. | | |
| Root 2.5 | Log. | 0.39794 | Root .2 | Log. | 9.301030 |
| Index..... | | 3 | Index..... | | 5 |
| Power 15.625 | Log. | 1.19382 | Power .00032 | Log. | 46.505150 |

## EVOLUTION.

EVOLUTION is the extracting of the root of a given power, or finding a number which, when raised to the given power, will produce the given number: it is consequently the reverse of involution, and is performed by dividing the logarithm of the number by the index of the power, and the quotient will be the logarithm of the root required.

When the given number is a decimal fraction, prefix to the index of its logarithm a figure lessened by one than the index of the power, and divide the whole by the index of the power.

EXAMPLES.

Required the square root of 225.

| | | |
|---|---|---|
| Power 225 | Log. 2) | 2. 35218 |
| Root 15 | Log. | 1. 17609 |

Required the square, or 2d root, of . 030276

| | | |
|---|---|---|
| Power . 030276 | Log. 2) | 18. 481098 |
| Root . 174 | Log. | 9. 240549 |

Required the cube root of 15. 625.

| | | |
|---|---|---|
| Power 15. 625 | Log. 3) | 1. 19382 |
| Root 2. 5 | Log. | 0. 39794 |

Required the 5th root of . 00032.

| | | |
|---|---|---|
| Power . 00032 | Log. 5) | 46. 505150 |
| Root . 2 | Log. | 9. 301030 |

## RULE OF THREE.

Rule. Add the logarithms of the second and third terms together, and from their sum subtract the logarithm of the first term, and the remainder will be the logarithm of the fourth term.

Or, add together the arithmetical complement* of the logarithm of the first term, and the logarithms of the second and third terms; the sum, rejecting 10 from the index, will be the logarithm of the fourth term, or proportional number.

EXAMPLES.

If a ship sail 49. 5 miles in 8 hours, how many miles will she run in 24 hours, supposing her to go at the same rate?

| | | |
|---|---|---|
| As 8 hours | Log. | 0. 90309 |
| Is to 49. 5 miles | Log. | 1. 69461 |
| So is 24 hours | Log. | 1. 38021 |
| | Sum | 3. 07482 |
| | | 0. 90309 |
| To 148. 5 miles | Log. | 2. 17173 |

Or thus,

| | | |
|---|---|---|
| As 8 hours Arith. Co. | Log. | 9. 09691 |
| Is to 49. 5 miles | Log. | 1. 69461 |
| So is 24 hours | Log. | 1. 38021 |
| To 148. 5 miles | Log. | 2. 17173 |

Suppose a watch or time-keeper gain 14 seconds in 5 days 6 hours, how much will it gain in 17 days 15 hours?

| | | |
|---|---|---|
| As 5. 25 days | Log. | 0. 720159 |
| Is to 14 seconds | Log. | 1. 146128 |
| So is 17. 625 days | Log. | 1. 246129 |
| | Sum | 2. 392257 |
| | | 0. 720159 |
| To 47 seconds | Log. | 1. 672098 |

Or thus,

| | | |
|---|---|---|
| As 5. 25 days Arith. Co. | Log. | 9. 279841 |
| Is to 14 seconds | Log. | 1. 146128 |
| So is 17. 625 days | Log. | 1. 246129 |
| To 47 seconds | Log. | 1. 672098 |

Note.—*See these Examples worked in Decimal Arithmetic.*

* For the method of finding the arithmetical complement of a logarithm, see Explanation to Table XXIV.

# PRACTICAL GEOMETRY.

## DEFINITIONS.

### I.

GEOMETRY* is the Science or doctrine of extension, or things extended; that is, of lines, surfaces, and solids; or it is that Science which treats of the descriptions, properties, and relations of magnitude in general.

### II.

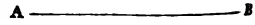
A POINT is that which hath no parts, being considered in Mathematics as indivisible, and may be expressed by a dot.

### III.

A LINE is that which is produced by the motion of a point, and has length without sensible breadth or thickness.

### IV.

A STRAIT LINE, or RIGHT LINE, is that which lies evenly between its extremes, without changing its direction, and is the nearest distance between the two points that terminate it, as A B.



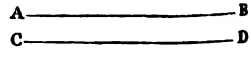

### V.

A CURVED LINE is that which is not the nearest distance between its extremes or ends, as C D.

A line is generally expressed by two letters at its extremes.

### VI.

PARALLEL LINES are such as are in the same direction, being in every part at the same distance from each other, and which, if infinitely extended, would never meet; as the lines A B, C D.




* Geometry originally meant nothing more than the Art of measuring the earth, and is said to have been invented by the Egyptians, who had recourse to it in order to ascertain the artificial boundaries of their land, which were entirely obliterated by the annual inundation of the Nile; but the Science, in its present extended sense, constitutes the principal foundation of all the Mathematics.

## VII.

A SUPERFICIES, or SURFACE, is that which is conceived to have length and breadth only, without any consideration of thickness, and its boundaries are lines.

## VIII.

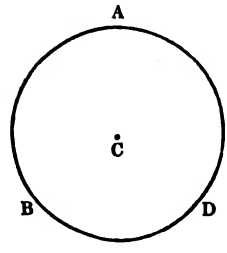
A PLANE SUPERFICIES is that which lies evenly between its extremes, so that a right line may wholly coincide with it in all parts and directions.

## IX.

A SOLID is that which hath length, breadth, and thickness, and its bounds or extremes are Superficies.

## X.

A CIRCLE is a plane figure bounded by a curved line, called the CIRCUMFERENCE, as A B D, which is in every part equally distant from a point within it, called the CENTRE, as C; it is formed by the revolution of a line about one of its extremities, which remains fixed.



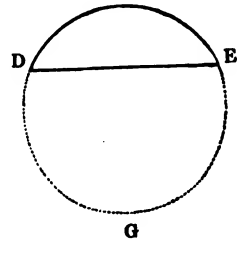

The circumference of itself is often called the circle, although properly the circle is the space contained within the circumference.

The circumference of every circle is usually supposed to be divided into 360 equal parts, called DEGREES; each degree into 60 equal parts, called MINUTES; each minute into 60 equal parts, called SECONDS; and so on.

Degrees, minutes, and seconds, are thus expressed, 40° 32′ 15″; that is 40 degrees, 32 minutes, and 15 seconds.

## XI.

An ARCH or ARC of a Circle is any part of the circumference, as D F E.

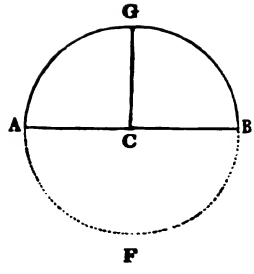



## XII.

A CHORD is a right line joining the ends of an Arch, as D E; it divides the Circle into two unequal parts, called SEGMENTS; as D F E and D G E.

## XIII.

A DIAMETER is a right line drawn through the centre of a circle, and terminated at both ends by the circumference, as A C B; it divides the circle into two equal parts, called SEMICIRCLES; as A G B and A F B.




## XIV.

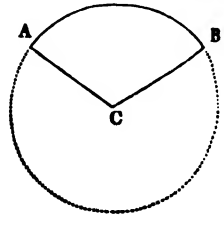
A QUADRANT is half a semicircle, or the fourth part of the whole circle, as A C G or G C B.

## XV.

A RADIUS, or SEMIDIAMETER, is a right line drawn from the centre to any part of the circumference, and is the extent taken in the compasses to describe a circle, as C A, C G, or C B.

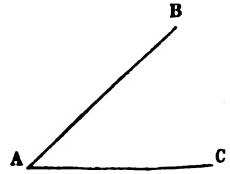
## XVI.

A SECTOR is any part of a circle comprehended between two radii and their included arch, as A C B.




## XVII.

An ANGLE is the inclination or opening of two lines meeting in one point: the point where they meet is called the ANGULAR POINT, as A; and the lines that include it, the SIDES or LEGS, as A B, or A C.

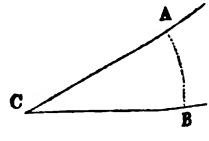



## XVIII.

An Angle is sometimes expressed by three letters, the middle one always denoting the angular point, and the other two the legs that include it; but generally by the letter at the angular point only; as the angle B A C, or the angle A.

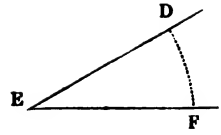
## XIX.

An angle is measured by an arch of a circle contained between its legs, making the angular point the centre of the circle; thus the arch A B is the measure of the angle A C B.



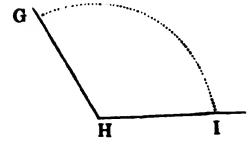
## XX.

Angles are said to be equal to each other when the arches that measure them are equal, as the angles A C B and D E F.




## XXI.

One angle is esteemed greater or less than another, according as the arch between its legs is greater or less; thus the angle G H I is greater than the angles A C B or D E F.




From the preceding Definitions it will appear evident that the measure of an angle does not depend on the length of its legs, but on their inclination only; for, as we have just seen, the angle G H I is greater than the angles A C B or D E F, although the legs of the latter are longer than those of the former.

## XXII.

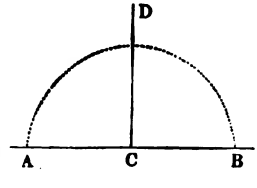
As all circles are supposed to be divided into 360 equal parts, called degrees, &c. a certain number of these divisions will be contained between the two legs of the angle; wherefore an angle is said to measure so many degrees, minutes, &c. as are contained in the arch between the legs.

## XXIII.

The arch which measures an angle may be described with any radius; for, since the whole circumference of every circle is supposed to be divided into the same number of parts, it hence follows that the divisions will be greater or less in the same proportion as the whole circumference.

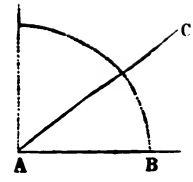
## XXIV.

When one right line falls upon another, so as to make the angles on each side of it equal, it is called a PERPENDICULAR, and the angles formed by these lines, as the angles A C D, D C B, are called RIGHT ANGLES; now as the semicircle A D B contains 180 degrees (the half of 360), all right angles will contain an arch of 90 degrees, equal to the fourth part of the whole circle.



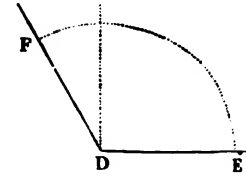
## XXV.

An ACUTE ANGLE is that which contains less than a right angle, or 90 degrees, as the angle C A B.




## XXVI.

AN OBTUSE ANGLE is that which contains more than a right angle, or 90 degrees, as the angle F D E.

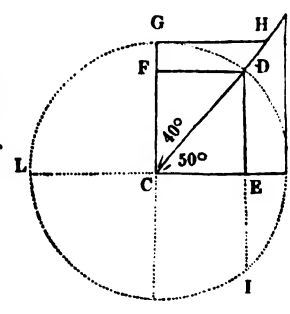



## XXVII.

Acute and obtuse angles are called OBLIQUE ANGLES.

## XXVIII.

The SINE or RIGHT SINE of an arch is a right line drawn from one extreme of the arch, perpendicular to a diameter drawn to the other extremity, and is equal to half the chord of double the arch; thus D E is the sine of the arch D B, and is equal to half the chord D I of double the arch D B I.




## XXIX.

The VERSED SINE of an arch is that part of a diameter contained between the sine and the arch; thus E B is the versed sine of the arch D B.

## XXX.

The TANGENT of an arch is a right line drawn perpendicular to the end of a diameter passing through one extremity of the arch, and continued till it meet a right line drawn from the centre through the other end of the arch; thus A B is the tangent of the arch D B.

## XXXI.

The SECANT of an arch is a right line drawn from the centre through one end of the arch, till it meet the tangent drawn from the other end: thus C A is the secant of the arch D B.

## XXXII.

The COMPLEMENT of an arch is what it wants of a right angle, or 90 degrees; thus G D is the complement of D B, or D B of D G.

## XXXIII.

The SUPPLEMENT of an arch is what it wants of two right angles, or 180 degrees; thus L D is the supplement of D B, or D B of L D.

## XXXIV.

The Co. SINE, Co. TANGENT, Co. SECANT, and Co. VERSED SINE of an arch, is the sine, tangent, secant, and versed sine of the complement of that arch; Co. being a contraction of the word complement: thus D F is the co. sine, G H the co. tangent, C H the co. secant, and G F the co. versed sine, of the arch D B; being the sine, tangent, &c. of the arch D G, the complement of the arch D B.

The sine, tangent, and secant of an arch, as of D B, is likewise the sine, tangent, and secant of the supplement of that arch, as of L D.

## XXXV.

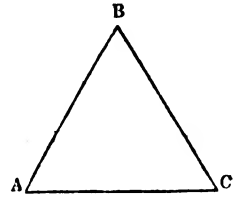
An angle being measured by an arch of a circle, (see Def. XIX.) the sine, tangent, &c. of an arch is the sine, tangent, &c. of the angle which is measured by the arch, or of the degrees and minutes, &c. that the arch contains; hence, supposing the arch D B, which measures the angle D C B, to contain 50 degrees, the lines D E, A B, A C, and E B, will be respectively the sine, tangent, secant, and versed sine of the angle A C B, or of 50 degrees; and consequently the co. sine, co. tangent, co. secant, and co. versed sine, of the angle G C D, or of 40 degrees, the complement of 50 degrees.

## XXXVI.

A PLANE TRIANGLE is a figure bounded by three right lines, and contains three angles, of which there are several kinds, both with respect to their sides and angles.

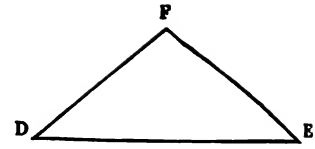
## XXXVII.

An EQUILATERAL TRIANGLE is that which has its three sides equal to one another, as A B C.



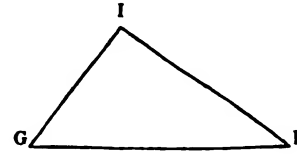
## XXXVIII.

An Isosceles Triangle is that which has only two sides equal, as DEF.



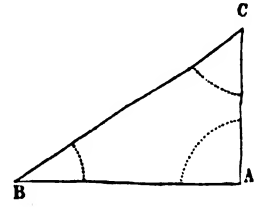

## XXXIX.

A Scalene Triangle is that whose sides are all unequal, as GHI.



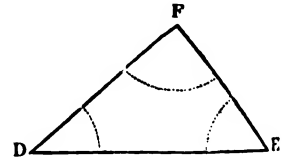

## XL.

A Right Angled Triangle is that which has one of its angles right, or containing 90 degrees, as the angle A; the side opposite the right angle is called the Hypothenuse, as BC; and the other two sides are called Legs, that which stands upright, the Perpendicular, as AC, and the other, the Base, as BA.



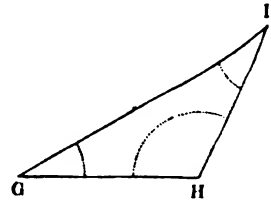

## XLI.

An Acute Angled Triangle is that which has all its Angles acute, as DEF.




## XLII.

An Obtuse Angled Triangle is that which has one of its angles obtuse, as the angle H in the triangle GHI.




## XLIII.

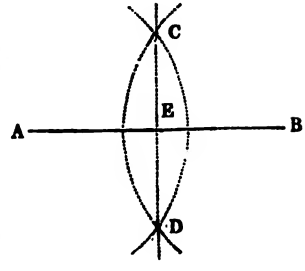
All triangles that are not right angled, whether they are acute or obtuse, are, in general terms, called Oblique Angled Triangles, without any other distinction.

# PROBLEMS.

## PROBLEM I.

*To divide a given right Line* A B *into two equal Parts.*

Take any extent in the compasses greater than half the line A B, and with one foot in B describe an arch; with the same radius, and one foot in A, describe an arch cutting the former in C and D; through C and D draw a right line, and this line will divide the given line A B into two equal parts at the point E.



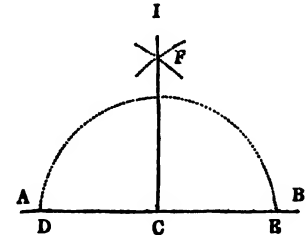

In this manner any arch of a circle may be divided into two equal parts.

## PROBLEM II.

*From a given Point* C, *in a given right Line* A B, *to raise a Perpendicular.*

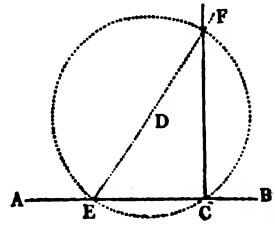
Case 1st. When the given point C is near the middle of the line A B.

With one foot of the compasses in C, at any distance, draw an arch cutting the line A B in D and E; from the points D and E, with any distance greater than C E or C D, describe two arches cutting each other in F; through the points F and C draw the line I C, and it will be perpendicular to the given line A B.

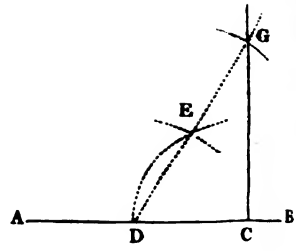



Case 2d. When the given point C is at, or near the end of the line A B.

Take any point out of the line, as D, and with the distance D C describe a circle, cutting the line A B in E and C; through the centre D and the point E draw the right line E F, cutting the circle in F; then a line drawn through F and C will be the perpendicular required.



*Or thus:* Describe the arch D E at any distance from C, and with one foot of the compasses in D, with the same extent, describe an arch cutting the arch D E in E; from this point, keeping the same extent in the compasses, draw the arch G; through D and E draw the right line D G, cutting the arch in G; then draw a right line through G and C, and it will be the perpendicular required.

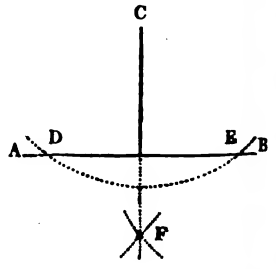



## PROBLEM III.

*From a given Point* C *to let fall a Perpendicular on a given right Line* A B.

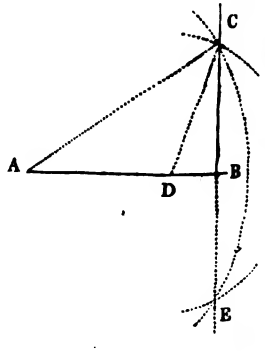
CASE 1st. When the point C is nearly opposite the middle of the line A B.

With one foot of the compasses in C, describe an arch cutting the line A B in D and E; from these points, at any distance, describe two arches cutting each other in F; through the points C and F draw a right line, and it will be perpendicular to the given line A B.




CASE 2d. When the given point C is nearly opposite to the end of the line A B.

Place one foot of the compasses in any part of the given line, as at A, and with the distance A C describe the arch C E; then, from any other part of the given line nearly under the point C, as at D, with the distance D C describe a small arch cutting the arch C E in E; then a line drawn through the points C and E will be perpendicular to the line A B.

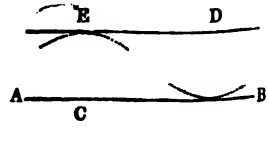



## PROBLEM IV.

*To draw a right Line parallel to a given right Line* A B.

CASE 1st. When the parallel line is to pass through a given point D.

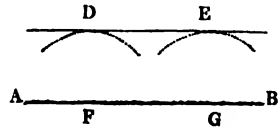
Take the nearest distance between the given point D and the right line A B; with that distance set one foot of the compasses on any



part of the line A B, as at C, and describe the arch E; from the point D draw a line so as just to touch the arch E without cutting it, and that line will be parallel to the given line A B through the given point D.

CASE 2d. When the parallel line is to be at a given distance from the right line A B.

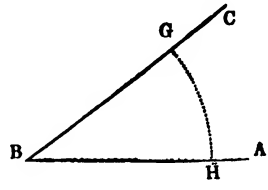
With the given distance in the compasses, describe two arches, D and E, from any two points, as F and G in the given right line; then a line D E drawn just touching the two arches without cutting them, will be parallel to the given line A B.

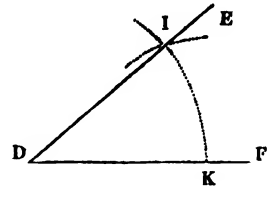



## PROBLEM V.

*At a given Point* D *in the right Line* D F, *to make an Angle* E D F *equal to a given Angle* C B A.

With one foot of the compasses in B, at any distance, describe the arch G H; through D draw the line D F, and keeping the same extent in the compasses, place one foot in D, and describe the arch in I K; then take the distance G H, apply it to the arch I K from K to I, and through the points D and I draw the line D E; the angle E D F will then be equal to the angle C B A, as was required.



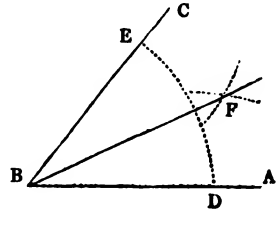




## PROBLEM VI.

*To divide a given Angle* A B C *into two equal Parts.*

From the angular point B, with any extent in the compasses, describe the arch D E; from D and E, with the same or any other extent, describe two arches cutting each other in F; through the points B and F draw a right line, and it will divide the angle into two equal parts.

In the same manner any given arch of a circle is bisected, when the centre of the circle is given.

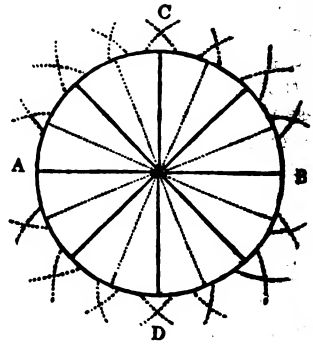


## PROBLEM VII.

*To divide a Circle* A B C D *into two, four, eight, sixteen, thirty-two, &c. equal Parts.*

Draw a diameter A B, and it will divide the circle into two equal parts; from the points A and B describe the arches at C and D; a line drawn through these will divide the circle into four equal parts; then bisect the arches A C, C B, &c. by the last problem, and the circle will be divided into eight equal parts, and so on by continual bisections.

This problem is useful in constructing the Mariner's Compass.

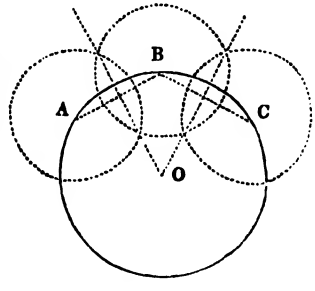



## PROBLEM VIII.

*To draw the Circumference of a Circle through any three given Points* A, B, C, *not situated in a right Line.*

Draw lines joining A B and B C, and bisect them by lines meeting in O, as directed in Problem I.; then from O, at the distance of any one of the points, as O A, describe a circle, and it will pass through the other points B and C, as required.

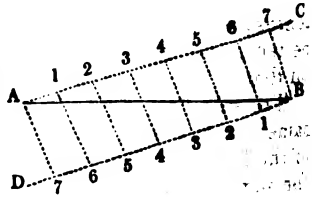
In this manner the centre of a circle may be found; for, taking any three points in the circumference, and proceeding as before directed, the lines meeting at O will give the centre required.




## PROBLEM IX.

*To divide a given Line* A B *into any proposed Number of equal Parts.*

Let it be required to divide the line A B into seven equal parts; from one end A, of the given line A B, draw a right line A C, makind any angle with A B, and from the other end B draw a line B D parallel to A C; on each of the lines A C, B D, beginning at A and B, set off as many equal parts as A B is to be divided into, *viz.* seven; then lines drawn from A to 7, 1 to 6, 2 to 5, 3 to 4, &c. will divide the given line into seven equal parts.



## PROBLEM X.

*To construct Scales of equal Parts.*

The simplest scale of equal parts is made by drawing a strait line, and dividing it with a pair of compasses into as many primary divisions as convenient, which, if the line be of a definite length, may be done by Prob. IX., and subdividing one of these decimally, or into ten equal parts; then each of the former may represent 10 units, as leagues, miles, &c., and in that case the latter will represent one of these units: or if the larger divisions be supposed to be 100, then the subdivisions will be tens, and so on. Suppose, for example, it were required to set off from the Scale 25 or 250: set one foot of a pair of compasses on 2 among the primary divisions, and the other on the 5th subdivision; then this extent will represent 25 or 250 miles, leagues, or any other measure of length, as may be required.

There are frequently several of these scales drawn parallel to each other, of different lengths, on a flat rule, (as Fig. 1, Plate I.); they are divided into as many equal parts as the length of the rule will admit; the numbers placed on the left hand shewing how many parts in an inch each scale is divided into. These scales are sometimes subdivided duodecimally, to adapt them to feet and inches when used in Mensuration; or sexagesimally, to represent degrees and miles on Maps and Charts.

But the most correct scale of equal parts is the DIAGONAL SCALE (Fig. 2, Plate I.), the larger divisions of which are commonly an inch or half an inch, and sometimes a quarter of an inch, subdivided into one hundred equal parts. To construct this scale, draw eleven equidistant parallel lines; divide the upper of these lines A E into such a number of equal parts as the scale is intended to contain; from each of these divisions draw perpendicular lines through the eleven parallels to the line C F; subdivide the first of these divisions A B and C D into ten equal parts, and from the point C to the first division in the line A B, draw a diagonal right line, and lines parallel to this through each succeeding subdivision; then will each diagonal line, in passing from the line B A to D C, be one-tenth of the subdivisions further from the line D B, at the points where they intersect each succeeding parallel from B A to D C, that is, one hundredth of the larger divisions, by which means it is divided into one hundred equal parts.

If, therefore, the larger divisions be accounted as units, the first subdivisions will be tenths, and the second, marked by the diagonals upon the parallels, hundredth parts; but if we suppose each of the larger divisions to represent ten, then the first subdivisions will be units, and the second tenths; or if the larger divisions be hundreds, then will the first subdivisions be tens, and the second units; so that the value of the subdivisions depends on that of the larger divisions.

The numbers 376, 37. 6, 3. 76, may therefore all be expressed by the same extent of the compasses: thus, setting one foot in the line marked 3 of the larger divisions, on the sixth parallel, and extending the other along the same parallel to the seventh diagonal, that distance will be the extent required; for if the three larger divisions be taken for 300, seven of the

first subdivisions will be 70, which, upon the sixth parallel, taking in six of the second subdivisions for units, make the whole number 376; or if the three larger divisions be taken for 30, seven of the first subdivisions will be seven units, and the six subdivisions, upon the sixth parallel, will be six-tenths of a unit: lastly, if three larger divisions be esteemed as only 3, then will the first subdivisions be seven-tenths, and the six second subdivisions be the six-hundredth parts of a unit.

## PROBLEM XI.

### *To construct Lines of Chords, Sines, &c.*

Describe a semicircle A D B with any convenient radius (Fig. 8, Plate I.), and upon the centre C erect the perpendicular C D, continued at pleasure to F; through B draw B E parallel to C F, and draw the right lines A D and D B. Divide the quadrant D B into 9 equal parts, and with one foot of the compasses in B and the distances B 10, B 20, &c. transfer them to the right line B D, which will be a LINE OF CHORDS.

Divide the quadrant A D into 8 equal parts, and with one foot of the compasses in A, and the distance A 1, A 2, &c. transfer them to the right line A D, and it will be a LINE OF RHUMBS, containing eight points of the compass.

From the points 10, 20, 30, &c. in the arch B D, draw lines parallel to D C, which will divide the radius C B into a LINE OF SINES, reckoning from C to B, or of VERSED SINES, if it be numbered from B to C; which may be continued to 180, if the same divisions be transferred to the line C A, the other half of the diameter.

From the centre C draw right lines through the several divisions of the quadrant D B, until they cut the line B E, which will become a LINE OF TANGENTS.*

Transfer the distances between the centre C and the divisions on the line of tangents, to the line D F, and these will give the divisions of the LINE OF SECANTS, which must be numbered from D towards F.

From A draw right lines through the several divisions of the arch B D, and they will divide the radius C D into a LINE OF SEMI-TANGENTS, which are to be marked with the corresponding figures of the arch D B.

Divide the radius A C into 6 equal parts; through each of these draw lines parallel to C D, intersecting the arch A D; then, with one foot of the compasses in A, and the distances of the arch A 50, A 40, &c. transfer these to the right line A D, and it will give the divisions of the LINE OF LONGITUDE.

If this line be laid upon the scale close to the line of chords, so that 60 on the line of longitude be opposite o on the chords, and any degree of latitude be counted on the chords, there will stand opposite to it, on the line of longitude, the miles contained in one degree of longitude in that latitude; the measure of a degree at the Equator being 60 miles.

* From the construction of the lines of chords, sines, and tangents, it is obvious that the chord of 60°, the sine of 90°, and the tangent of 45°, are all equal to the radius of the circle.

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# CONSTRUCTION OF THE LINES ON THE PLANE SCALE &c.




Fig: 5.

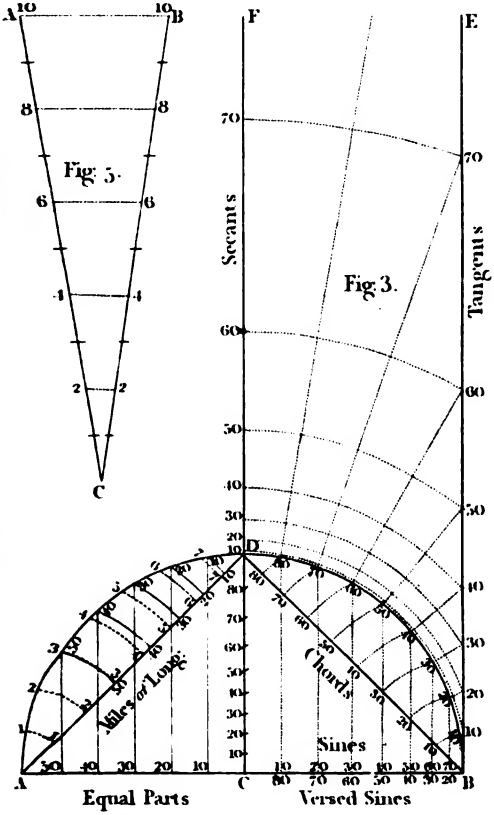



Fig: 3.

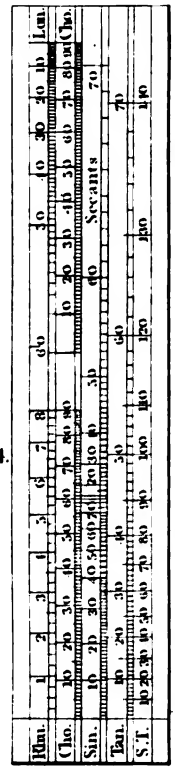



Fig: 4.

Fig: 1. *COMMON SCALE OF EQUAL PARTS.*

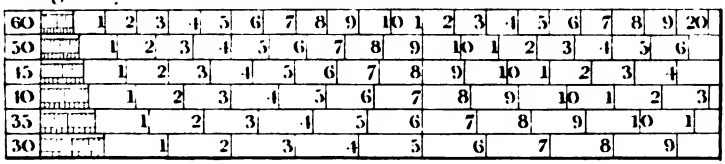
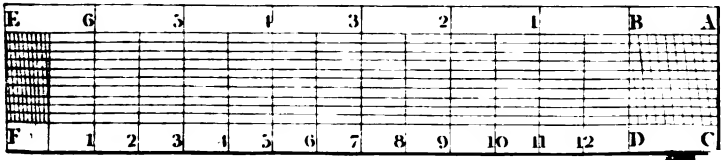


Fig: 2. *DIAGONAL SCALE OF EQUAL PARTS.*

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In the figure the divisions are given only to every tenth degree, and each point of the compass, which is sufficient to explain the method of Construction; but in Figure 4, these lines are graduated to degrees, and the rhumbs to quarters, and placed parallel, as exhibited on one side of a flat rule, which, with the scale of equal parts on the other side, constitutes the instrument called a PLANE SCALE.

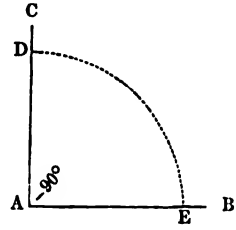
Besides the lines already mentioned, there are frequently on the Plane Scale a line of leagues, and a few other lines, which are only so many scales of equal parts, each having the equal divisions of different lengths, for the more readily laying down lines and figures of different lengths and magnitudes.

## PROBLEM XII.

### *To make an Angle that shall contain any proposed Number of Degrees.*

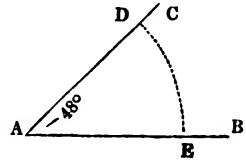
CASE 1st. When the given angle is right, that is, contains 90 degrees.

Draw the line A B, and from the scale take the extent of the chord of 60 degrees in the compasses; then set one foot of the compasses in A, and with the other describe the arch E D, and set off thereon, from E to D, the distance of the chord of 90°; through A and D draw the right line A C, then will the angle B A C be a right angle. By this method a perpendicular may easily be raised on a given line, since the angle formed by one line that is perpendicular to another, is always a right angle.



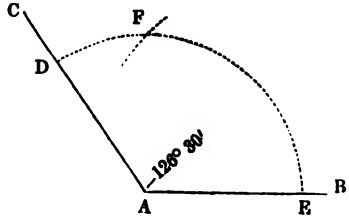

CASE 2d. When the angle is to be acute; suppose one that shall contain 48 degrees.

Draw the line A B, and with one foot of the compasses in A (the chord of 60 degrees being taken as before), draw the arch E D, on which set off 48 degrees from E to D; through A and D draw the right line A C; then will the angle B A C be made, containing 48 degrees, as was required.




CASE 3d. When the angle is to be obtuse; suppose one that shall contain 126° 30′.

Draw A B, and from the point A, with the chord of 60°, as before, draw the arch D E, and, as the divisions on the scale extend no further than 90°, first set off 90° from E to F; then set off the remainder, or excess above 90°, that is, 36° 30′, from F to D; through A and D draw the line A C, and the angle B A C will contain 126° 30′.



### PROBLEM XIII.

*To measure a given Angle* B A C.

With one foot of the compasses in the angular point, and with the chord of 60 degrees, describe the arch D E (see the Figures in Problem XII.) cutting the legs in D and E; then the distance D E applied to the line of chords, from the beginning, will shew the measure of the angle B A C, if it contain less than 90 degrees; but when the arch exceeds that quantity, take 90 degrees from the line of chords, and set it off from E to F; then measure the excess D F, and their sum will give the measure of the angle required.

The construction of triangles will be explained in Trigonometry; but before the learner begin that subject, we would recommend him, if he have time, to study the use of Gunter's Scales and the Sector, as these instruments will afford him easy, elegant, and concise methods of resolving triangles.

## DESCRIPTION AND USE OF GUNTER'S SCALES.

### OF THE COMMON GUNTER.

This instrument is a flat rule, usually two feet in length, and about an inch and a half broad, having on one side equal parts, rhumbs, chords, &c. as on the Plane Scale; and on the other the logarithms of these numbers: hence the lines on this side are called logarithmic lines. They were invented by Mr. Edmund Gunter, who applied the logarithms of numbers, and of sines and tangents, to strait lines, by taking the lengths expressed by the figures in those logarithms from a scale of equal parts, and applying them to lines, as laid down on the Rule.

On the logarithmic side of the common Gunter are the eight following lines:

1. *A Line of Sine Rhumbs*, marked S. R., which contains the logarithms of the natural sines of every point and quarter point of the compass, numbered from the left hand towards the right, with 1, 2, 3, 4, 5, 6, 7, 8, where a brass pin is fixed.

2. *A Line of Tangent Rhumbs*, marked T. R., corresponding to the logarithms of the tangent of every point and quarter point of the compass. This line is numbered 1, 2, 3, 4, from left to right, and back again with 5, 6, 7, from the right towards the left. To take off any number of points below 4, we must reckon from the 1 towards the right hand; but any number of points above 4 we count towards the left hand.

3. *A Line of Numbers*, marked NUM., on which most of the others depend, contains the logarithms of numbers, and is figured from the left

hand of the scale towards the right to 1 or 10, near the middle of the scale; these divisions are subdivided into ten unequal parts, and these again into ten, five, or two parts, as room will permit: the whole of these divisions and subdivisions are repeated from the middle towards the right hand, being exactly of the same lengths, but ten times the value of the corresponding numbers in the first part.

If the 1 at the beginning of the line represent 1 unit, the next primary division, marked 2, will represent 2 units, and the middle 1 will be 10, the following 2 will be 20, the 3 will stand for 30, and so on, the 10 at the right hand representing 100. If the left hand 1 stands for 10, then the 2 will stand for 20, the 3 for 30, the middle 1 for 100, the following 2 for 200, and the 10 on the right hand for 1000; in like manner, if the first 1 be esteemed 1 tenth, the next following 2 will be 2 tenths, the middle 1 will be 1 unit, the next 2 will be 2 units, and the 10 at the end will be 10 units. Again, if the first 1 be counted 1 hundredth part, the next 2 will be 2 hundredth parts, the middle 1 will stand for 10 hundredth parts, or 1 tenth, the next 2 for 2 tenths, and the 10 at the end will stand for 1 unit, or whole number.

It is manifest that the value of the subdivisions must depend on that of the primary divisions; for, suppose the first 1 at the left hand be reckoned for 1 unit, then the first following principal subdivision will be 1 tenth, the second 2 tenths, and so on to the next primary division, which will represent 2 units; reckoning on in the same manner till you come to the middle 1, which will represent 10, then the next following principal subdivision will be 11, the next 12, where a brass pin is fixed; the next primary division 20, and so on to 100: and in the same way will the smaller subdivisions be valued.

As this line is of great importance, we shall add a few examples, to render what has been said the more clear. Suppose the point representing 25 be required:—the primary division 2 on either half is to be reckoned for 20; then counting forwards to the right, to the fifth principal subdivision, that point will represent 25, or 250, or 2500, &c. Again, let the point representing 146 be required. Here the 1 at the beginning, or in the middle, may be esteemed 100, the fourth principal subdivision on the right will then be 140, and because the interval between 140 and 150 is divided into 5 parts, each will be valued as 2; therefore, counting forwards 3 of these latter subdivisions, that point will represent 146.

Once more; suppose the place of 1785 be required:—the one at the beginning or middle is to be taken as 1000, the seventh following principal subdivision will be 1700; the fourth following smaller subdivision will be 1780, and the fourth part of the next smaller subdivision will be the point representing 1785.

4. *A Line of Sines*, marked SIN., beginning at the left hand, and numbered towards the right at each degree as far as 10, and then at each 10th degree to 90: the subdivisions under 10 degrees are usually 10 minutes; from 10 to 20 each is a quarter of a degree; from 20 to 40 each is half a degree; from 40 to 80 each is 1 degree; and from 80 to 90 each is 5 degrees.

5. *A Line of Versed Sines*, marked V. S.: it is numbered from the right towards the left, at each 10th degree as far as 160; the subdivisions from 20 to 90 are usually each two degrees; from 90 to 140 one degree; and from 140 to the end half a degree.

6. *A Line of Tangents*, marked TAN.: it is numbered from the left hand towards the right as far as 45 degrees, which is equal to radius, or the sine of 90 degrees; and, since the log. tangent of an arch above 45 degrees is the arithmetical complement of the tangent of an arch as much less than 45 degrees, the same division represents 40 or 50 degrees, 30 and 60, and so on; for if the line of tangents were continued beyond 45 on the right, the divisions would be exactly the same length, only reversing the order: therefore, instead of such continuation, it is more convenient to reckon the degrees above 45 backwards, or from right to left, observing at the same time that the degrees above 45 are to be supposed, when using the line, increasing towards the right hand, as in the other parts of the line.

The subdivisions on this line are nearly the same as on the line of sines; indeed these, as well as the other lines, are variously subdivided on different scales, according to the accuracy and goodness of the instrument.

7. *A Line of Meridional Parts*, marked MER., reckoned from right to left, each larger division representing 10 degrees, and the smaller each 1 degree, or 60 meridional miles.

8. *A Line of equal Parts*, marked E. P., numbered from right to left, each large division representing 10 degrees of the equator, or 600 miles. The first of these divisions is sometimes divided into 10 equal parts, each representing a degree, or 60 miles, and these again into halves or quarters of 30 or 15 miles each.

## USE OF THE LINE OF NUMBERS.

Multiplication is performed on this line by extending the compasses from 1 to either of the factors*, and that extent will reach from the other factor to the product.

Suppose, for example, it were required to find the product of 16 multiplied by 5: set one foot of the compasses in 1, and the other in 5, then that extent will reach from 16 to 80, the product required.

When the product contains four figures, the fourth cannot be well ascertained by the scale, but it may be easily found by multiplying the unit figures of the factors, and the unit figure of their product will be that of the product required. For example, suppose it were required to find the product of 22 by 16; the extent from 1 to 16 will reach from 22 to about 350, but as the divisions are too small to distinguish the last figure, therefore multiply 2 by 6, which will give the product 12; hence the product required is 352.

Division being the reverse of Multiplication, extend from the divisor to 1, and that extent will reach from the dividend to the quotient.

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* The factors are numbers multiplied, of which one is called the multiplier, and the other the multiplicand.

Example—Divide 80 by 5. Extend from 5 to 1, and that extent will reach from 80 to 16, the quotient required.

To reduce a Vulgar Fraction to a Decimal, extend from the denominator to the numerator, and that extent will reach from 1 to the decimal fraction required.

Example—Required the decimal fraction equal to $\frac{3}{4}$. Extend from 4 to 3, and that extent will reach the same way from 1 to .75, the decimal required.

To perform the Rule of Three—State the question so that the first and third terms may be of the same name; then the fourth term will be of the same name with the second, and greater or less than the second, as the third is greater or less than the first; then extend the compasses from the first to the third term, and that extent will reach from the second to the fourth term.

Example—If a ship sail at the rate of 26 miles in 3 hours, how many miles will she sail in 24 hours?

Here, as 3 hours is to 26 miles, so is 24 hours to the answer; therefore, extend from 3 to 24, and that extent will reach from 26 to 208, the miles required.

To find the area, or superficial content of a square, or rectangle, extend from 1 to the breadth, and that extent will reach from the length to the superficial content.

Example—Suppose a board or plank measure 18 inches broad, and 25 feet in length, required the superficial content.

Extend from 1 to 1.5, (= 1 foot 6 inches), and that extent will reach from 25 feet to 37.5, or 37 feet 6 inches, the contents required.

To find the solid contents of a bale, box, chest, &c. or any other rectangular solid, extend from 1 to the breadth, and that extent will reach from the length to a fourth number; then extend from 1 to the depth, and that extent will reach from the fourth number to the solid contents.

Example—Required the solid contents of a box measuring 3 feet broad, 5.5 feet long, and 2 feet in depth.

Extend from 1 to 3, and that extent will reach from 5.5 to 16.5; then extend from 1 to 2, and that extent will reach from 16.5 to 33 feet, the solid contents.

## USE OF THE LINES OF SINES AND TANGENTS.

These lines are used with the line of numbers in working proportions in Trigonometry, by the Rule above, as will be fully exemplified when we treat on that subject.

## USE OF THE LINE OF VERSED SINES.

This line is used with the line of sines in resolving a spherical triangle when the three sides are given to find the angles, or the three angles, to find the sides, as will be explained in the methods of working an azimuth.

### USE OF THE LINES OF MERIDIONAL AND EQUAL PARTS.

These lines are always used together, and only in Mercator's Sailing, or in constructing a Mercator's Chart. When the meridional parts answering to a given latitude are required, they are found by taking the extent from the beginning of the line of meridional parts to the given latitude: this extent being applied to the line of equal parts will give, in degrees, the meridional parts required. Or, if the meridional difference of latitude between two places be wanted, the extent from one latitude to the other on the line of meridional parts will give, when applied to the line of equal parts, the meridional difference of latitude in degrees, which are to be reduced to miles.

## OF THE SLIDING GUNTER.

This instrument is nearly of the same dimensions as the common Gunter, but consists of three pieces of wood; the extreme pieces being connected by thin plates of brass at each end, and the third made to slide in grooves between them. The lines on this scale are constructed and graduated as on the Plane Scale and common Gunter: we shall therefore only remark here, that there are two lines of numbers, sines, and tangents—one on the fixed part of the scale, and the other on the slide—and that there is likewise a third line of numbers on the slide opposite a line of sine rhumbs.

### USE OF THE LINE OF NUMBERS.

To perform Multiplication by these lines, set 1 on the sliding line to one of the factors on the fixed line; then opposite the other factor on the slide will be found the product on the fixed line.

Example—To find the product of 16 multiplied by 5, draw out the slide until 1, on its line of numbers, coincide with 5 on the fixed line; then opposite 16 on the sliding line, will be 80 on the fixed line.

Division is performed by drawing out the slide until the divisor on its line coincide with the dividend on the fixed line; then opposite to 1 on the sliding line will be the quotient on the fixed line.

Example—To divide 124 by 4, set 4 on the sliding line to coincide with 124 on the fixed line; then opposite to 1 on the slide will be 31 on the fixed line, which is the quotient required.

To work the Rule of Three, let the question be stated so that the first and third terms may be of the same name, then the fourth term will consequently be of the same name with the second, and greater or less than the second, as the third is greater or less than the first. Now, set the first term on the sliding line opposite to the third term on the fixed line, and the fourth term will be found on the fixed line, opposite to the third term on the sliding line.

Examples—If 3 yards of cloth cost 21 shillings, what will be the value of 27 yards? Now, as 3 yards : 21 shs. :: 27 yds. : the answer; therefore

set 3 on the sliding line of numbers to 27 on the fixed line, then opposite to 21 on the sliding line will be found 189 on the fixed line, the fourth term or number of shillings required, equal to £9. 9s. Again, suppose a ship sail 170 miles in 24 hours, at what rate is that per hour? As 24 hrs. : 170 miles :: 1 hour : the answer. Set 24 on the sliding line of numbers to 1 on the fixed line; then opposite to 170 on the sliding line is $7\frac{1}{10}$ on the fixed line, the miles and parts that the ship sails per hour.

## DESCRIPTION AND USE OF THE SECTOR.

This instrument is formed of two equal rules or legs, moveable about a centre or joint, on the faces of which are drawn several lines or scales, some proceeding from the centre, called SECTORAL LINES, and others parallel to the edge of the rules, similar to those laid down upon a common Gunter.

The sectoral lines are drawn twice on the same face of the instrument, that is, once on each leg; those on one face are, 1. Two scales of equal parts, marked LIN. or L.; each of these scales, from the great extensiveness of its use, is called the LINE OF LINES. 2. Two lines of chords, marked CHO. or C. 3. Two lines of secants marked SEC. or S. 4. Two lines of polygons, marked POL.—Upon the other face the sectoral lines are, 1. Two lines of sines, marked SIN. or S. 2. Two lines of tangents, marked TAN. or T. 3. Between the lines of tangents and sines, two other lines of tangents, marked *t*, to a less radius, to supply the defect of the former, and extending from 45 to about 75 degrees.

The lines of chords, sines, tangents, and secants, are constructed upon the same principle as those on the Plane Scale, making the length of the line of chords the radius of the circle. (See Geom. Prob. XI.)

Each pair of the sectoral lines (except the line of polygons) are numbered from the centre, and so disposed as to make equal angles at the centre, consequently at whatever distance the Sector be opened, the angles will always be respectively equal; that is, the distance between 10 and 10 on the lines of lines will be equal to 60 and 60 on the lines of chords, 90 and 90 on the lines of sines, and 45 and 45 on the lines of tangents.

The other lines on the Sector being for the most part such as are usually drawn upon the Gunter's Scale, which have already been described, it will be unnecessary here to enumerate them; we shall therefore only observe that the logarithmic lines, being placed partly on one leg, and partly on the other, are to be used with the legs fully opened.

The use of the sectoral lines is founded on a property of similar triangles, namely, that their corresponding sides are proportional. Let C B, C A, (Fig. 5, Plate I.) represent a pair of sectoral lines, forming the angle A C B; divide them each into any number of equal parts, as ten for instance, and

draw lines to the corresponding numbers on each line, as from 2 to 2, 4 to 4, &c. These lines will form a series of triangles, as c 2 2, c 4 4, &c. all similar to the triangle c a b; therefore it will be, as c 2 is to c a, so is 2 2 to 10 10, or a b; and as c 2 is to 2 2, so is c a to a b, and so on for the other corresponding lines.

Hence also if the lines c a, c b, represent the lines of chords, sines, tangents, or secants; and if c a be the radius, and the line c 2 the chord, sine, tangent, or secant, of any proposed number of degrees; then the line 2 2 will be the chord, sine, &c. of the same number of degrees to the radius a b.

We shall now proceed to explain some of the most important uses to which the sectoral lines may be applied; previous to which it will be necessary to observe, that in all operations the distances are to be taken with a pair of compasses from the innermost of the three lines which bound the divisions, that being the line proceeding from the centre: it is likewise to be understood, that the measure taken from the centre to any part of a sectoral line, is called a *lateral distance*, and that the measure taken from any point in one line to its corresponding point in a line of the same name, is called a *transverse*, or *parallel distance*.

## USE OF THE LINES OF LINES.

1. *To divide a given line into any number of equal parts:* for example suppose 9. Take the length of the given line in the compasses, and make it a transverse distance from 9 to 9, the number of parts proposed; then will the transverse distance of 1 and 1 be one of the equal parts, or the 9th part of the whole; and the transverse distance of 2 and 2 will be 2 of the equal parts, or $\frac{2}{9}$ of the whole line, and so on.

*Note.*—When the line to be divided is too long to be applied to the legs of the Sector, take some aliquot part of it, as the half, the third, &c. and double or triple the lengths of the transverse distances taken from the Sector.

2. *To divide a given line into any number of parts that shall be in any assigned proportion;* as, suppose three parts, in the proportion of 2, 3, and 4. Make the given line a transverse distance to 9, the sum of the proposed numbers 2, 3, 4; then the transverse distances of these numbers severally will be the parts required.

3. *To find a fourth proportional to three given lines or numbers;* as, suppose to 8, 4, and 6. Take the lateral distance of 4 in the compasses, and make it the transverse distance of 8; then the transverse distance of 6, extended from the centre, will reach to the fourth proportional 3. If a ship sail 36 miles in 4 hours, what distance will she sail in 7 hours? Open the Sector till the transverse distance of 4 and 4 be equal to the lateral distance 36; then the transverse distance of 7 laid off from the centre will give 63, the fourth proportional.

Suppose three lines a b, c d, and e f, given to find a fourth proportional. Take the length of the line a b in the compasses, and placing one foot in the centre, mark what point or division the other foot falls on: open the Sector

till the parallel distance between that point and the corresponding one on the other leg is equal to the line C D; then E F taken in the compasses and laid off as a lateral distance, the corresponding transverse distance will be the length of the line required.

Let it be required to reduce a chart drawn on a scale of 5 inches to a degree, to a scale of 3 inches to a degree. Make the transverse distance from 5 to 5 equal to the lateral distance of 3; the legs of the Sector being kept at this angular position, any measure taken from the chart being laid off as a lateral distance, the corresponding transverse distance will be the measure to be laid down upon the reduced chart.

4. *Having a line containing any given number of equal parts, to find the length of a line containing any other number of the same parts.*

Suppose a chart to be drawn on a scale of 5 miles to 3 inches; required the length of any other number of miles upon the same scale. Make the transverse distance of 5 and 5 equal to 3 inches; the legs of the Sector being kept at this angular position, the transverse distance of any other number, within the limits of the Sector, will be the length of the number of miles required.

5. *Having the number of parts contained in any given line, to find the number of the same parts contained in another line.*

Suppose the length of one side of a triangle measure 30, what are the measures of the other sides? Take the length of the given side in the compasses, and apply it transversely from 30 to 30; to this opening of the Sector apply the length of the other sides transversely, so that the points may fall upon corresponding divisions, and these will shew the measure of the sides required.

## USE OF THE LINES OF CHORDS.

1. *To protract or lay down an angle of any given number of degrees.* At any opening of the Sector take the transverse distance of 60°, with which extent describe an arch; then take the transverse distance of the proposed number of degrees, and apply it to that arch: through the extremities of this distance on the arch, draw two lines from the centre, and they will form the angle required. When the angle exceeds 60°, lay it off at twice or thrice.

In this manner any number of degrees may be laid off on the circumference of a given circle, making the transverse distance of 60° equal to the radius of the circle.

2. *To measure any given angle.* With any radius describe an arch from the angular point, and set that radius transversely from 60 to 60; then take the length of the intercepted arch in the compasses, and apply it transversely to the line of chords, so that the points of the compasses may fall upon corresponding divisions, and they will shew the measure of the given angle.

## USE OF THE LINES OF SINES, TANGENTS, AND SECANTS.

1. *Having the length of the radius of a circle, to find the length of the chord, sine, or tangent of any arch of that circle.* Suppose the chord, sine, or tangent of 30 degrees to a radius of 2 inches be required: open the Sector till the transverse distance of 60 and 60 on the lines of chords be equal to 2 inches; then will the same extent reach from 45 to 45 on the lines of tangents, and from 90 to 90 on the lines of sines, so that to whatever radius the lines of chords are set, to the same are all the others set. In this angular position of the legs, therefore, if the transverse distance between 30 and 30 be taken on the lines of chords, sines, or tangents, with the compasses, it will give the length of the chord, sine, or tangent of 30 degrees, to the radius of 2 inches. When the required chord is above 60°, or the tangent above 45°, as suppose 70 degrees, proceed thus: for the chord take the transverse distance of half the arch, *viz.* 35 degrees, on the line of sines, the double of which gives the length of the chord of 70 degrees. To find the tangent of 70 degrees to the same radius, make the transverse distance from 45 to 45, on the upper lines of tangents, equal to 2 inches; then the extent between 70 and 70 on the same lines will be the length of the tangent required.

2. *Having the radius of a circle, to find the secant of any arch of that circle:* as again, suppose of 20 or 70 degrees, to a radius of 2 inches; make 2 inches the transverse distance between 0 and 0 on the lines of secants; then will the transverse distance of 20 and 20, or 70 and 70, give the secant of 20 or 70 degrees.

3. *The radius of a circle, and any line representing a sine, tangent, or secant of an arch of that circle being given, to find the degrees and parts corresponding to that line.* Open the Sector to the given radius, according as a sine, tangent, or secant is concerned, then, taking the given line in the compasses, apply the legs transversely till they fall on the corresponding divisions of the proper line, and these will point out the degrees and parts required.

In this manner the angles of a right-angled triangle may be estimated, by considering one side as the radius of a circle, and one of the other sides as representing the sine, tangent, or secant of the required angle.

The sectoral lines are likewise useful in working proportions in Trigonometry: suppose, for example, the hypothenuse of a triangle measures 56, and the angle opposite the perpendicular 32 degrees; to find the perpendicular, the proportion will be, as radius, or sine of 90° is to the hypothenuse 56, so is sine of the angle opposite the perpendicular 32° to the perpendicular; therefore make the transverse distance of 90 and 90 on the lines of sines equal to the lateral distance 56 on the lines of lines; then the transverse distance of 32° on the line of sines, applied as a lateral distance to the lines of lines, will give 29. 5 for the length of the perpendicular required.

# PLANE TRIGONOMETRY.

PLANE TRIGONOMETRY is that branch of Geometry which teaches to compute the sides and angles of plane triangles; it is divided into right-angled and oblique-angled Trigonometry, according as it is applied to the mensuration of right or oblique-angled triangles.

## RIGHT-ANGLED TRIGONOMETRY.

### DEFINITIONS AND PRINCIPLES.

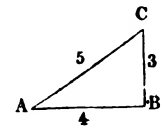
1. Every triangle consists of six parts; namely, three sides and three angles.

2. The sum of the three angles of every plane triangle is equal to two right angles, or 180 degrees; hence, if one of the angles be known, the sum of the other two may be found by subtracting the given angle from 180 degrees: also, if two of the angles be known, their sum, subtracted from 180 degrees, will give the third angle: again, in a right-angled triangle (the right angle containing 90 degrees), the sum of the two acute angles is equal to 90 degrees: therefore, if one of the acute angles be given, the other will be found by subtracting the given angle from 90 degrees.

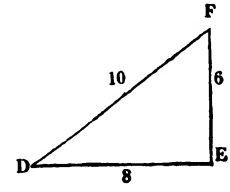
3. Any two sides of a triangle added together are greater than the third side.

4. The greatest side of a triangle is opposite the greatest angle, and the least side opposite the least angle; also, in the same triangle, equal sides are opposite to equal angles.

5. Two triangles are said to be similar when all the angles of the one are respectively equal to all the angles of the other; as for instance, the triangle A B C is similar to the triangle D E F, because the angles A, B, and C, are respectively equal to the angles D, E, and F.

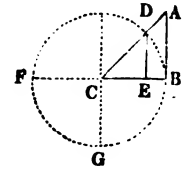


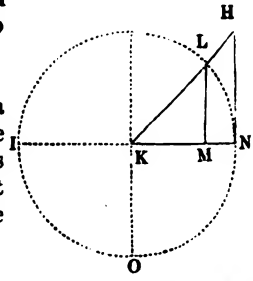

6. The sides of similar triangles, opposite to equal angles, are proportional; thus in the triangles A B C and D E F, as A B is to D E, so is A C to D F, and so is B C to E F. Or as 4 : 8 :: 5 : 10 :: 3 : 6.



7. Similar arches of unequal circles are such as contain the same number of degrees, &c. of their respective circles.

8. The sines, tangents, and secants of similar arches are proportional to the radii of the circles; thus, supposing the arch D B, of the circle D B G F, to be similar to the arch L N, of the circle L N O I, then D E is to I M, A B to H N, and C A to K H, as C B or C D is to K N or K L; that is, the sine, tangent and secant of one arch is to the sine, tangent, and secant of the other, as the radius of one circle is to the radius of the other.




Hence, if the radius of a circle be divided into a certain number of equal parts, and the length of the sine, tangent, or secant of any angle in such parts be given, the length of the sine, tangent, or secant of the same angle to any other radius may be found.

9. The lengths of the sine, tangent, and secant for every degree and minute of the quadrant, whose radius is 1, being calculated and arranged in a table, is called a TRIGONOMETRICAL CANON: and the logarithms of these lengths are called logarithmic or artificial sines, tangents, and secants; as in Table XXV. of this Work.

From these Principles are deduced the following

## RULES

### *For computing the Sides and Angles of right-angled Triangles.*

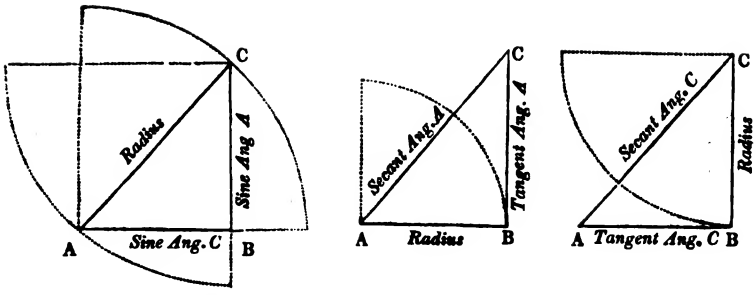
In every right-angled triangle there must be two parts given, besides the right angle, to find the other three; and one of these parts at least must be a side, because the angles will only give the proportion, not the absolute length of the sides.

In every right-angled triangle one of the sides must be considered as representing the radius of a circle; then,

1. If the *Hypothenuse* be made radius, the perpendicular and base will each be the sine of its opposite angle.

2. If the *Base* be made radius, the perpendicular will be the tangent of its opposite angle, and the hypothenuse the secant of the same angle.

3. If the *Perpendicular* be made radius, the base will be the tangent of its opposite angle, and the hypothenuse the secant of the same angle; the sine, tangent, or secant of one angle being, in each case, the co. sine, co. tangent, or co. secant of the other.




Thus, if in the triangles A B C, the hypothenuse A C be considered as radius of a circle, then it is evident the perpendicular B C will be the sine of the angle A, and the base A B the sine of the angle C; if the base A B be made radius, then the perpendicular B C will be the tangent of the angle A, and the hypothenuse A C the secant of angle A; if the perpendicular B C be made radius, then the base A B will be the tangent of the angle C, and the hypothenuse the secant of angle C

Since the acute angles A and C contain together 90 degrees, they are the complements of each other; therefore the sine, tangent, and secant of angle A is the co. sine, co. tangent, and co. secant of angle C; and the sine, &c. of angle C is the co. sine, &c. of angle A. (See Definition XXXIV. Geom.)

*To find a Side.*

Consider any one of the sides as representing the radius of a circle, and write upon it the word *radius;* then upon the other sides write the parts they represent according to the preceding Rules, which call the *names* of the sides; then say,

As the name of the given side
Is to the given side,
So is the name of the side required
To the side required.

*To find an Angle.*

Consider one of the given sides as representing the radius of a circle, and write upon it the word *radius;* and upon the other sides write the parts they represent according to the preceding Rules; then say,

As the side representing radius
Is to radius,
So is the other given side
To the sine, tangent, or secant of the angle by it represented.

Having raised the canons, or proportions, they may be worked by the common Rule of Three, taking the lengths of the sines, tangents, or secants of the angles, to Radius 1, from the proper Table; but as logarithms considerably abbreviate the calculation, by performing Multiplication by Addition, and Division by Subtraction, it is more usual to take out the

logarithms of the three given terms (the logarithm of radius being 10.00000); then, adding the logarithms of the second and third terms together, and from their sum subtracting the logarithm of the first term, the remainder will be the logarithm of the fourth term, which being found in the proper Table, the number, or the degrees and minutes corresponding to it, will give the required side or angle.

NOTE. The logarithms for sides are to be taken from Table XXIV., and for the sines, tangents, or secants of angles, from Table XXV.

We shall now proceed to exemplify the above Rules by the following Cases, which we shall resolve by three different methods: *viz.* by Geometrical Construction, by Logarithmic Calculation and by Gunter's Scale.

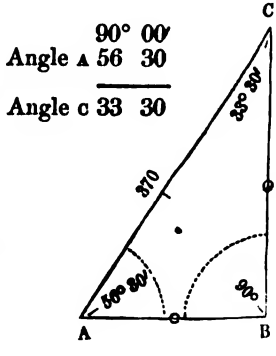
## CASE I.

### *The Angles and the Hypothenuse given, to find the Base and the Perpendicular.*

EXAMPLE. Given the hypothenuse A C, 370 miles, (or any other measure of length), the angle A 56° 30′, and consequently the angle C 33° 30′; required the base A B and perpendicular B C.

BY CONSTRUCTION.

Draw the line A B of any length, and make the angle at A 56° 30′ (Problem XII. Geometry); from A to C lay off 370, the length of the hypothenuse, taken from any convenient scale of equal parts, and from the point C let fall the perpendicular C B (Prob. III. Geom.); then A B C is the triangle required: the base A B, measured on the same scale of equal parts by which the hypothenuse was measured, will be 204. 2, and the perpendicular B C 308. 5.




| | |
|---|---|
| | 90° 00′ |
| Angle A | 56 30 |
| Angle C | 33 30 |

BY CALCULATION.

Making the hypothenuse radius, A B will be the sine of angle C, and C B the sine of angle A; then,

| *To find the Base* A B. | | *To find the Perpendicular* B C. | |
|---|---|---|---|
| As radius | 10. 00000 | As radius | 10. 00000 |
| Is to hypoth. AC 370 | 2. 56820 | Is to hypoth. AC 370 | 2. 56820 |
| So is sine ang. C 33° 30′ | 9. 74189 | So is sine ang. A 56° 30′ | 9. 92111 |
| | 12. 31009 | | 12. 48931 |
| | 10. 00000 | | 10. 00000 |
| To the base AB 204. 2 | 2. 31009 | To the perpend. BC 308. 5 | 2. 48931 |

Making the base radius, B C will be the tangent, and A C the secant of angle A; then

| *To find the Base.* | | *To find the Perpendicular.* | |
|---|---|---|---|
| As sec. of ang. A 56° 30′ | 10. 25811 | As sec. of ang. A 56° 30′ | 10. 25811 |
| Is to hypoth. AC 370 | 2. 56820 | Is to hypoth. AC 370 | 2. 56820 |
| So is radius | 10. 00000 | So is tan. of ang. A 56° 30′ | 10. 17922 |
| | 12. 56820 | | 12. 74742 |
| | 10. 25811 | | 10. 25811 |
| To the base AB 204. 2 | 2. 31009 | To the perpend. BC 308. 5 | 2. 48931 |

Making the perpendicular radius, A B will be the tangent, and A C the secant, of angle C; then,

| *To find the Base.* | | *To find the Perpendicular.* | |
|---|---|---|---|
| As sec. of ang. C 33° 30 | 10. 07889 | As sec. of ang. C 33° 30′ | 10. 07889 |
| Is to hypoth. AC 370 | 2. 56820 | Is to hypoth. A C 370 | 2. 56820 |
| So is tan. ang. C 33° 30′ | 9. 82078 | So is radius | 10. 00000 |
| | 12. 38898 | | 12. 56820 |
| | 10. 07889 | | 10. 07889 |
| To the base AB 204. 2 | 2. 31009 | To the perpend. B C 308. 5 | 2. 48931 |

BY GUNTER'S SCALE.*

1st. Extend the compasses from radius†, or 90°, to angle C 33° 30′ on the line of sines, and that extent will reach from the hypothenuse 370 to 204. 2, the measure of the base, on the line of numbers

2dly. Extend the compasses from radius, or 90°, to angle A 56° 30′ on the line of sines, and that extent will reach from the hypothenuse 370 to 308. 5, the measure of the perpendicular, on the line of numbers.

---

* In working the several Cases by Gunter's Scale, we shall always suppose the hypothenuse radius, where it can be done, being the most simple of the three.

† Radius, on Gunter's Scale, is either 8 points on the line of sine rhumbs, 4 points on the line of tangent rhumbs, 90 degrees on the line of sines, or 45 degrees on the line of tangents.

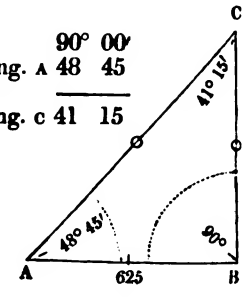
## CASE II.

*The Angles and one of the Legs given, to find the Hypothenuse and the other Leg.*

EXAMPLE. Given the base A B 625, and the angle A 48° 45′, to find the hypothenuse A C, and the perpendicular B C.

BY CONSTRUCTION.

Draw the base A B, which make equal to 625, taken from a scale of equal parts; and upon B erect the perpendicular B C (Prob. II. or XII. Geom.); make the angle A equal to 48° 45′ (Prob. XII. Geom.), and draw the hypothenuse A C to cut the perpendicular B C in the point C; then A C, measured on the same scale of equal parts that A B was, will be 947.9, and B C 712.7.




BY CALCULATION.

Making the hypothenuse radius, A B will be the sine of angle C, and C B the sine of angle A; then,

| *To find the Hypothenuse.* | | *To find the Perpendicular* | |
|---|---|---|---|
| As sine of ang. c 41° 15′ | 9.81911 | As sine of ang. c 41° 15′ | 9.81911 |
| Is to the base A B 625 | 2.79588 | Is to the base A B 625 | 2.79588 |
| So is radius | 10.00000 | So is sine of ang. A 48° 45′ | 9.87612 |
| | 12.79588 | | 12.67200 |
| | 9.81911 | | 9.81911 |
| To the hypoth. A C 947.9 | 2.97677 | To the perpend. B C 712.7 | 2.85289 |

Making the base radius, B C will be the tangent, and A C the secant, of angle A; then,

| *To find the Hypothenuse.* | | *To find the Perpendicular.* | |
|---|---|---|---|
| As radius | 10.00000 | As radius | 10.00000 |
| Is to the base A B 625 | 2.79588 | Is to the base A B 625 | 2.79588 |
| So is the sec. of ang. A 48° 45′ | 10.18089 | So is tan. of ang. A 48° 45′ | 10.05701 |
| | 12.97677 | | 12.85289 |
| | 10.00000 | | 10.00000 |
| To the hypoth. A C 947.9 | 2.97677 | To the perpend. B C 712.7 | 2.85289 |

Making the perpendicular radius, A B will be tangent, and A C secant, of angle C; then,

| *To find the Hypothenuse.* | | *To find the Perpendicular.* | |
|---|---|---|---|
| As tang. of ang. C 41° 15′ | 9.94299 | As tang. of ang. C 41° 15′ | 9.94299 |
| Is to the base A B 625 | 2.79588 | Is to the base A B 625 | 2.79588 |
| So is sec. of ang. C 41° 15′ | 10.12387 | So is radius | 10.00000 |
| | 12.91975 | | 12.79588 |
| | 9.94299 | | 9.94299 |
| To the hypoth. A C 947.9 | 2.97676 | To the perpend. B C 712.7 | 2.85289 |

BY GUNTER'S SCALE.

1st. Extend the compasses from angle C 41° 15′ to radius, or 90° on the line of sines, and that extent will reach from the base 625 to the hypothenuse 947.9 on the line of numbers.

2dly. Extend the compasses from angle C 41° 15′ to angle A 48° 45′ on the line of sines, and that extent will reach from the base 625 to the perpendicular 712.7 on the line of numbers.

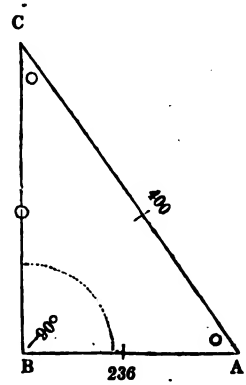
## CASE III.

*The Hypothenuse and one Leg given, to find the Angles and the other Leg.*

EXAMPLE. Given the hypothenuse A C 400, and the base B A 236; required the angles A and C, and the perpendicular B C.

BY CONSTRUCTION.

Draw the base B A, which make equal to 236; upon B erect the perpendicular B C, (Prob. II. or XII. Geom.), and taking the distance 400 in the compasses, place one foot in A, and let the other foot cross B C in C, and draw the line A C; then will the perpendicular B C measure 323, the angle C 36° 9′, and the angle A 53° 51′ (Prob. XIII. Geom.)



### BY CALCULATION.

Making the hypothenuse radius, B A will be the sine of angle C, and B C the sine of angle A; then,

| *To find the Angles.* | | *To find the Perpendicular.* | |
|---|---|---|---|
| As the hypoth. A C 400 | 2. 60206 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to the hypoth. A C 400 | 2. 60206 |
| So is the base B A 236 | 2. 37291 | So is sine of ang. A 53° 51′ | 9. 90713 |
| | 12. 37291 | | 12. 50919 |
| | 2. 60206 | | 10. 00000 |
| To sine of ang. C 36° 9′ | 9. 77085 | To the perpend. B C 323 | 2. 50919 |
| 90 0 | | | |
| Angle A 53 51 | | | |

Making the base radius, B C will be the tangent, and A C the secant, of angle A; then,

| *To find the Angles.* | | *To find the Perpendicular.* | |
|---|---|---|---|
| As the base B A 236 | 2. 37291 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to the base B A 236 | 2. 37291 |
| So is the hypoth. 400 | 2. 60206 | So is tan. of ang. A 53° 51′ | 10. 13635 |
| | 12. 60206 | | 12. 50926 |
| | 2. 37291 | | 10. 00000 |
| To sec. of ang. A 53° 51′ | 10. 22915 | To the perpend. B C 323 | 2. 50926 |
| 90 00 | | | |
| Angle C 36 9 | | | |

### BY GUNTER'S SCALE.

1st. Extend from the hypothenuse 400 to the base 236 on the line of numbers, and that extent will reach from radius 90° to angle C 36° 9′ on the line of sines; hence the angle A will be 53° 51′.

2dly. Extend from radius 90° to angle A 53° 51′ on the line of sines, and that extent will reach from the hypothenuse 400 to the perpendicular 323 on the line of numbers.

NOTE. The perpendicular may be found, independent of the angles, thus: subtract the square of the base from the square of the hypothenuse; the square root of the remainder will be the length of the perpendicular required.

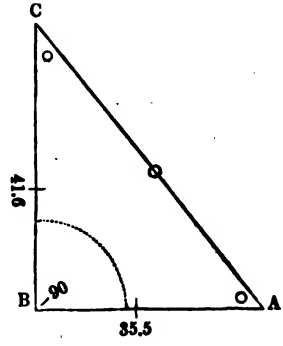
## CASE IV.

*The Base and Perpendicular given, to find the Angles and the Hypothenuse.*

EXAMPLE. Given the base B A 35. 5, and the perpendicular B C 41. 6; required the angles A and C, and the hypothenuse A C.

BY CONSTRUCTION.

Draw the line B A, and upon B raise the perpendicular B C (Prob. II. or XII. Geom.); make B A equal to 35. 5, and B C equal to 41. 6, and draw the line A C; then the hypothenuse A C will measure 54. 7, the angle A 49° 31′, and the angle C 40° 29′ (Prob. XIII. Geom.).




BY CALCULATION.

Making the base radius, B C will be the tangent, and A C the secant, of angle A.

| *To find the Angles.* | | *To find the Hypothenuse.* | |
|---|---|---|---|
| As the base B A 35. 5 | 1. 55023 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to the base B A 35. 5 | 1. 55023 |
| So is the perpend. B C 41. 6 | 1. 61909 | So is sec. of ang. A 49° 31′ | 10. 18760 |
| | 11. 61909 | | 11. 73783 |
| | 1. 55023 | | 10. 00000 |
| To tan. of ang. A 49° 31′ | 10. 06886 | To the hypoth. A C 54. 68 | 1. 73783 |
| 90 00 | | | |
| Angle C 40 29 | | | |

Making the perpendicular radius, B A will be the tangent, and A C the secant, of angle C.

| *To find the Angles.* | | *To find the Hypothenuse.* | |
|---|---|---|---|
| As the perpend. B C 41. 6 | 1. 61909 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to perpend. B C 41. 6 | 1. 61909 |
| So is the base B A 35. 5 | 1. 55023 | So is sec. of ang. C 40° 29′ | 10. 11885 |
| | 11. 55023 | | 11. 73794 |
| | 1. 61909 | | 10. 00000 |
| To tan. of ang. C 40° 29′ | 9. 93114 | To the hypoth. A C 54. 69 | 1. 73794 |
| 90 00 | | | |
| Angle A 49 31 | | | |

### BY GUNTER'S SCALE.

1st. Extend the compasses from the base 35. 5 to the perpendicular 41. 6 on the line of numbers, and that extent will reach from radius 45° to angle A 49° 31′ on the line of tangents*: hence angle C will be 40° 29′.

2dly. Extend the compasses from angle C 40° 29′ to radius 90° on the line of sines, and that extent will reach from the base 35. 5 to the hypothenuse 54. 68 on the line of numbers.

### EXAMPLES FOR EXERCISE.

1. Given the hypothenuse 108, and the angle opposite the perpendicular 25° 36′; required the base and perpendicular.

Answer. The base is 97. 4, and the perpendicular 46. 66.

2. Given the base 96, and its opposite angle 71° 45′; required the perpendicular and the hypothenuse.

Answer. The perpendicular is 31. 66, and the hypothenuse 101. 1.

3. Given the perpendicular 360, and its opposite angle 58° 20′; required the base and the hypothenuse.

Answer. The base is 222, and the hypothenuse 423.

4. Given the base 720, and the hypothenuse 980; required the angles and the perpendicular.

Answer. The angles are 47° 17′ and 42° 43′, and the perpendicular 664. 8.

5. Given the perpendicular 110. 3, and the hypothenuse 176. 5; required the angles and the base.

Answer. The angles are 38° 41′ and 51° 19′, and the base 137. 8

6. Given the base 360, and the perpendicular 480; required the angles and the hypothenuse.

Answer. The angles are 53° 8′ and 36° 52′, and the hypothenuse 600.

7. Given the base 346. 5, and the adjacent angle 35° 24′; required the perpendicular and hypothenuse.

Answer. The perpendicular 246. 2, and the hypothenuse 425. 1.

8. Given the hypothenuse 36. 5, and the angle opposite the base 65° 15′; required the perpendicular and base.

Answer. The perpendicular 15. 28, and the base 33. 15.

9. Given the perpendicular 725, and the adjacent angle 21° 36′; required the base and hypothenuse.

Answer. The base 287. 1, and the hypothenuse 779. 8.

10. Given the base 32. 76, and the hypothenuse 56. 95; required the angles and the perpendicular.

Answer. The angles are 35° 7′ and 54° 53′, and the perpendicular 46. 58.

---

* The same point represents both 49° 31′ and 40° 29′; but as the third term is more than the first, the angle A, or fourth term, will consequently be more than 45°, which is radius, or the second term on the line of tangents.

11. Given the perpendicular 98. 4, and the hypothenuse 1013; required the angles and the base.

Answer. The angles are 5° 84′ and 84° 26′, and the base 1009.

12. Given the base 4567, and the perpendicular 3251; required the angles and the hypothenuse.

Answer. The angles are 35° 27′ and 54° 33′, and the hypothenuse 5606.

## OBLIQUE-ANGLED TRIGONOMETRY.

### RULES

For computing the Sides and Angles of Oblique-angled Triangles.

I. *When two of the three given Parts are a Side, and its opposite Angle.*

To find a Side.

As the sine of any given angle
Is to its opposite side,
So is the sine of any other given angle
To its opposite side.

To find an Angle.

As any given side
Is to the sine of its opposite angle,
So is any other given side
To the sine of its opposite angle.

When the given side, opposite the given angle, is greater than the other given side, then the angle opposite that other given side, is always acute; but when the given side, opposite the given angle, is less than the other given side, then the angle opposite that other given side may be either acute or obtuse, which consequently must be determined from the nature of the triangle.

II. *When two Sides and the Angle contained between them are given.*

As the sum of the two given sides
Is to their difference,
So is the tangent of half the sum of the unknown angles
To the tangent of half their difference:

This half difference added to half the sum of the unknown angles, gives the greater angle, and subtracted, leaves the less angle. The angles being thus all known, the remaining side is to be found by Rule I.

### III. *When the three Sides are given, to find the Angles.*

As the base, or greatest side,
Is to the sum of the other two sides,
So is the difference of those sides,
To the difference of the segments made by a perpendicular let fall from the greatest angle upon the base.

Then half this difference added to half the sum of the segments—that is, half the base—gives the greater segment, and subtracted, gives the less segment. Hence the triangle will be divided into two right-angled triangles, in each of which there will be given the hypothenuse and the base, to find the other angles, which may be done by Rule I., or by those in Right-angled Trigonometry.

## CASE I.

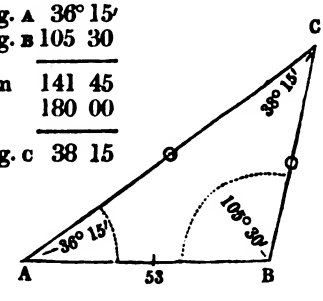
### *The Angles and one Side given, to find the other Sides.*

EXAMPLE. Given the angle A 36° 15′, the angle B 105° 30′, and the side A B 53; required the sides A C and B C.

BY CONSTRUCTION.

Draw the line A B, and make it equal to 53; make the angle B A C 36° 15′, and the angle A B C 105° 30′, (Prob. XII. Geom.), and draw the lines A C and B C till they meet in C; then A C will measure 82. 5, and B C 50. 62.

| | | |
|---|---|---|
| Ang. A | 36° | 15′ |
| Ang. B | 105 | 30 |
| Sum | 141 | 45 |
| | 180 | 00 |
| Ang. C | 38 | 15 |




BY CALCULATION.

| *To find the Side A C by Rule I.* | |
|---|---|
| As sine of ang. C 38° 15′ | 9. 79176 |
| Is to the side A B 53 | 1. 72428 |
| So is sine of ang. B* 105° 30′ | 9. 98391 |
| | 11. 70819 |
| | 9. 79176 |
| To the side A C 82. 5 | 1. 91643 |

| *To find the Side B C by Rule I.* | |
|---|---|
| As sine of ang. C 38° 15′ | 9. 79176 |
| Is to the side A B 53 | 1. 72428 |
| So is sine of ang. A 36° 15′ | 9. 77181 |
| | 11. 49609 |
| | 9. 79176 |
| To the side B C 50. 62 | 1. 70433 |

* For the manner of finding the log. sine of 105° 30′, see Explanation of Table XXV.

### BY GUNTER'S SCALE.

1st. Extend the compasses from the angle C 38° 15′ to 74° 30′, the supplement of angle B, on the line of sines, and that extent will reach from the side A B 53 to the side A C 82. 5 on the line of numbers.

2d. Extend the compasses from the angle C 38° 15′ to the angle A 36° 15′ on the line of sines, and that extent will reach from the side A B 53 to the side B C 50. 6 on the line of numbers.

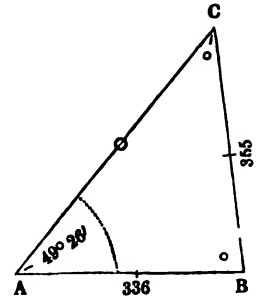
## CASE II.

*Two Sides and an Angle opposite one of them given, to find the other Angles and the third Side.*

EXAMPLE. Given the side A B 336, the side B C 355, and the angle A 49° 26′; required the angles B and C, and the side A C.

### BY CONSTRUCTION.

Draw the line A B, which make equal to 336; draw the line A C so as to make an angle of 49° 26′ with A B (Prob. XII. Geom.); take the length of B C in the compasses, and setting one foot in B, let the other cut the line A C in C, and draw the line B C; then the angle B will measure 84° 36′, the angle C 45° 58′ (Prob. XIII. Geom.), and the side A C 465. 3.




### BY CALCULATION.

*To find the Angle* C *by Rule I.*

| | | |
|---|---|---|
| As the side B C 355 | | 2. 55023 |
| Is to sine of ang. A 49° 26′ | | 9. 88061 |
| So is the side A B 336 | | 2. 52634 |
| | | 12. 40695 |
| | | 2. 55023 |
| To sine of ang. C 45° 58′ | | 9. 85672 |
| Ang. A 49 26 | | |
| Sum 95 24 | | |
| 180 00 | | |
| Ang. B 84 36 | | |

*To find the Side* A C *by Rule I.*

| | |
|---|---|
| As sine of ang. A 49° 26′ | 9. 88061 |
| Is to the side B C 355 | 2. 55023 |
| So is sine of ang. B 84° 36′ | 9. 99807 |
| | 12. 54830 |
| | 9. 88061 |
| To the side A C 465. 3 | 2. 66769 |

### BY GUNTER'S SCALE.

1st. Extend the compasses from the side B C 355 to the side A B 336 on the line of numbers, and that extent will reach from angle A 49° 26′ to angle C 45° 58′ on the line of sines; hence the angle B is 84° 36′.

2d. Extend the compasses from the angle A 49° 26′ to the angle B 84° 36′ on the line of sines; and that extent will reach from the side B C 355 to the side A C 465. 3 on the line of numbers.

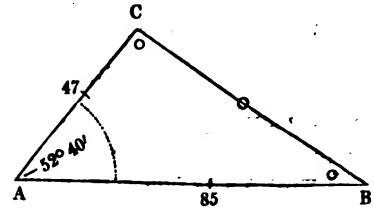
## CASE III.

*Two Sides and their contained Angle given, to find the other Angles and the third Side.*

EXAMPLE. Given the side A B 85, the side A C 47, and the angle A 52° 40′: required the angles C and B, and the side B C.

### BY CONSTRUCTION.

Draw the line A B, and make it equal to 85; at A make the angle B A C 52° 40′ (Prob. XII. Geom.); from A to C lay off 47, and draw the line B C; then A B C is the triangle required; the angle B will measure 33° 29′, the angle C 93° 51′ (Prob. XIII. Geom.), and the side B C 67. 7.




### BY CALCULATION.

*To find the Angles by Rule II.*

| | | | | | |
|---|---|---|---|---|---|
| Side A B | 85 | | As the sum of the sides A B, A C, | 132 | 2. 12057 |
| Side A C | 47 | | Is to their difference | 38 | 1. 57978 |
| Sum | 132 | | So is tang. of half the sum of angles B and C | 63° 40′ | 10. 30543 |
| Diff. | 38 | | | | 11. 88521 |
| | | | | | 2. 12057 |
| | | 180° 00′ | | | |
| Angle A | | 52 40 | To tang. of half their diff. | 30° 11′ | 9. 76464 |
| Sum of ang. B & C | | 127 20 | Sum gives the greater ang. C | 93 51 | |
| Half sum | | 63 40 | Diff. gives the less ang. B | 33 29 | |

*To find the Side B C by Rule I.*

| | | |
|---|---|---|
| As sine of ang. B | 33° 29′ | 9. 74170 |
| Is to the side A C | 47 | 1. 67210 |
| So is sine of angle A | 52° 40′ | 9. 90043 |
| | | 11. 57253 |
| | | 9. 74170 |
| To the side B C | 67. 74 | 1. 83083 |

NOTE. This triangle may be solved by letting fall a perpendicular from the angle C on the side A B, which will divide it into two right-angled triangles; then with the hypothenuse A C and angle A find the perpendicular and the base, which base subtracted from the side A B, will leave the base of the other triangle; then, with the perpendicular and base find the angle B, which added to angle A, and their sum subtracted from 180°, will give the angle C, and with one of the angles and its opposite side find the side B C.

### BY GUNTER'S SCALE.

1st. Extend the compasses from the sum of the two sides 132 to their difference 38; that extent will reach from 45° to a division* (16° 4′) on the line of tangents; then, the extent from this division to half the sum of the unknown angles 63° 40′, will reach from 45° to half their difference 30° 11′ on the line of tangents, by which the angles may be found as above.

2d. Extend from angle B 33° 29′ to angle A 52° 40′ on the line of sines; that extent will reach from the side A C 47 to the side B C 67. 7 on the line of numbers.

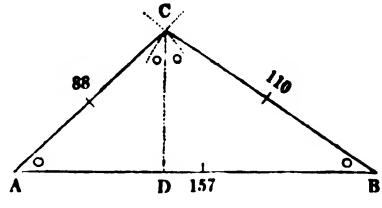
## CASE IV.

### *The three Sides given, to find the Angles.*

EXAMPLE. Given the side A B 157, the side B C 110, and the side A C 88, to find the angles A, B, and C.

### BY CONSTRUCTION.

Draw the line A B, which make equal to 157; take the length of A C 88 in the compasses, and with one foot on A describe the arch C; then, with the length of C B 110 in the compasses, and one foot in B, describe an arch cutting the former in C, to which draw the lines A C and B C; then A B C is the triangle required; the angle A will measure 42° 44′, the angle B 32° 53′, and the angle C 104° 23′ (Prob. XIII. Geom.)




* The necessity of noting this division arises from the line of tangents being read off from right to left above 45°, instead of being reckoned on towards the right; hence, in this case the point of the compasses falling without the Rule, the distance between this division and 63° 40′ gives the extent above 45°, which being applied to 45° backwards, falls upon the same division it would if the line were continued to the right.

## BY CALCULATION.

*To find the Segments* A D, D B, *by Rule III.*

| | | | |
|---|---|---|---|
| Side A C 88 | As the base or greatest side A B, | 157 | 2. 19590 |
| Side B C 110 | Is to the sum of the sides A C, B C, | 198 | 2. 29666 |
| Sum 198 | So is the diff. of the sides A C, B C, | 22 | 1. 34242 |
| | | | 3. 63908 |
| Difference 22 | | | 2. 19590 |
| | To the diff. of the segments A D, D B | 27. 74 | 1. 44318 |
| | Half the diff. of the segments | 13. 87 | |
| | Half their sum, or of the base A B | 78. 5 | |
| | Sum gives the greater segment D B | 92. 37 | |
| | Diff. gives the less segment A D | 64. 63 | |

*To find the Angles by Rule I.*

| | | | |
|---|---|---|---|
| As the side A C 88 | 1. 94448 | As the side B C 110 | 2. 04139 |
| Is to radius, or sine 90° | 10. 00000 | Is to radius, or sine 90° | 10. 00000 |
| So is the segment A D 64. 63 | 1. 81043 | So is the segment D B 92. 37 | 1. 96553 |
| | 11. 81043 | | 11. 96553 |
| | 1. 94448 | | 2. 04139 |
| To sine of ang. A C D 47° 16′ | 9. 86595 | To sine of ang. B C D 57° 7′ | 9. 92414 |
| 90 00 | | 90 00 | |
| | Ang. A C D 47° 16′ | | |
| Angle C A D 42 44 | Ang. B C D 57 7 | Ang. C B D 32 53 | |
| | Sum gives Angle A C B 104 23 | | |

## BY GUNTER'S SCALE.

1st. Extend the compasses from the base 157 to the sum of the two sides 198 on the line of numbers; that extent will reach from the difference of the sides 22, to the difference of the segments 27. 7; hence the segments will be found as above.

2d. Extend the compasses from the side A C 88, to the lesser segment A D 64. 6 on the line of numbers; that extent will reach from 90° to the angle A C D 47° 16′ on the line of sines; hence the angle C A D is 42° 44′.

3d. Extend the compasses from the side C B 110 to the greater segment 92. 4; that extent will reach from 90° to the angle D C B 57° 7′ on the line of sines; hence the angle C B D is 32° 53′

## EXAMPLES FOR EXERCISE.

1. Given one side 129, an adjacent angle 56° 30′, and the opposite angle 81° 36′: required the third angle and the remaining sides.

Answer. The third angle is 41° 54′, and the remaining sides are 108. 7 and 87. 08.

2. Given one side 96. 5, another side 59. 7, and the angle opposite the latter side 31° 30′: required the remaining angles and the third side.

Answer. This question is ambiguous, the given side opposite the given angle being less than the other given side (see Rule I.); hence, if the angle opposite the side 96. 5 be acute, it will be 57° 38′, the remaining angle 90° 52′, and the third side 114. 2; but if the angle opposite the side 96. 5 be obtuse, it will be 122° 22′, the remaining angle 26° 8′, and the third side 50. 32.

3. Given one side 110, another side 102, and the contained angle 113° 36′: required the remaining angles and the third side.

Answer. The remaining angles are 34° 37′ and 31° 47′, and the third side is 177. 5.

4. Given the three sides respectively, 120. 6, 125. 5, and 146. 7: required the angles.

Answer. The angles are 51° 53′, 54° 58′, and 73° 9′.

5. Given one side 684. 5, another side 496. 7, and the angle opposite the latter side 40° 58′: required the remaining angles and the third side.

Answer. If the angle opposite the former side be acute, the remaining angles will be 64° 37′ and 74° 25′, and the third side 729. 8; but if obtuse, the angles will be 115° 23′ and 23° 39′ and the third side 303. 9.

6. Given one side 117. 8, another side 96. 55, and the contained angle 67° 30′: required the remaining angles and the third side.

Answer. The remaining angles are 64° 41′ and 47° 49′, and the third side 120. 4.

7. Given the three sides 87. 6, 66. 2, and 41. 3: required the angles.

Answer. The angles are 25° 24′, 46° 20′, and 108° 16′.

8. Given one side 80, an adjacent angle 40°, and the sum of the other sides 130: required the remaining angles and the other sides.

Answer. The remaining angles are 66° 22′, and 73° 38′, and the sides 53. 6 and 76. 4.

9. Given one side 564, its opposite angle 56° 30′, and the sum of the other sides 1046 (one of the adjacent angles being obtuse): required the remaining angles and the other sides.

Answer. The remaining angles are 90° 22′ and 33° 8′, and the sides 676. 3 and 369. 7.

10. Given one side 36. 5, the opposite angle 15° 30′, and the difference of the other sides 18: required the remaining angles and the other sides.

Answer. The remaining angles are 111° 30′ and 53° 0′, and the sides 127. 1 and 109. 1.

# GEOGRAPHY.

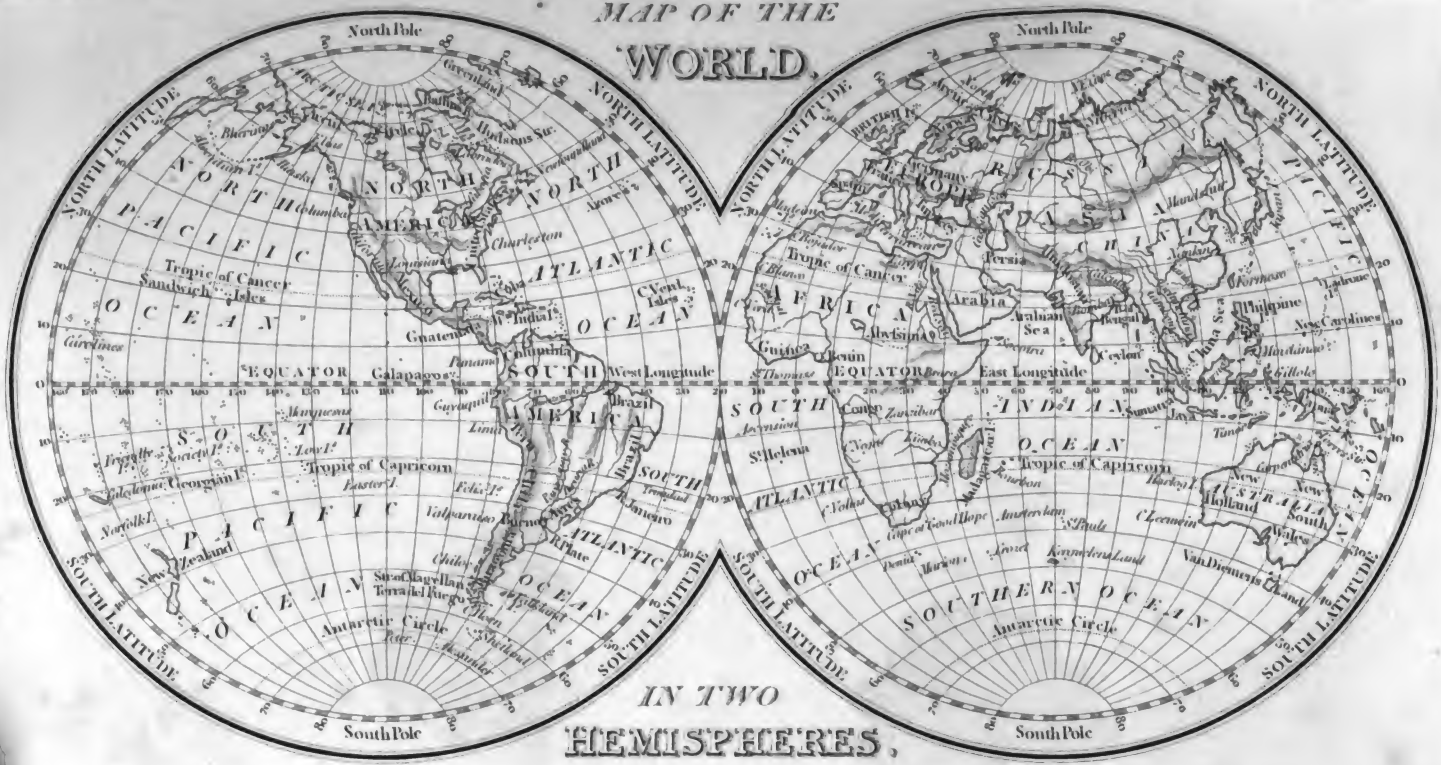
GEOGRAPHY is a description of the figure, magnitude, and positions of the several parts of the surface of the earth.

## OF THE FIGURE AND MAGNITUDE OF THE EARTH.

Various opinions were entertained by the ancients respecting the figure of the earth. Some imagined it an immense plane surrounded by an impassable ocean; others, that it was cylindrical; and some that it was a sphere or globe: which last opinion is now ascertained to be nearly the truth. The most obvious of the several arguments which prove the sphericity of the earth, and what must particularly strike every mariner, are, that when approaching the shores of countries, the points of high rocks, lighthouses, steeples of churches, and other thin but lofty objects, come into view much sooner than houses or other buildings of greater magnitude, but less height; in like manner, when ships are approaching each other at sea, the masts and rigging are discerned some time before the hull and lower parts of the vessel, though much larger, come to view. Again, seamen, it is well known, frequently discover distant lands from the tops of a ship's masts, long before they are visible to those who stand upon deck. These circumstances prove that the surface of the earth is convex; and as the same appearances happen wherever the observer is situated, this convexity must be uniform: hence we conclude that the earth is globular. The sphericity of the earth is likewise demonstrated by navigators who have sailed quite round it, by constantly going westward, and arriving home from the eastward, which could not be effected were the earth a plane: thus Ferdinand Magellan, setting out on the west side of Spain, continued shaping his course westward till he returned home on the south-eastern side of Spain; and thus also have Drake, Dampier, Cook, and others, circumnavigated the earth; and when, in addition to these facts, it is recollected that all the rules of Navigation are conformable to the opinion of the earth being nearly globular, and that these rules never lead the mariner into material error, these well-known circumstances, without adducing others (though others equally or more forcible might be adduced), must sufficiently establish the belief, in the mind of every impartial and competent judge, that the earth deviates but very little in its form from that of a sphere.

Supposing the earth to be in the exact form of a sphere, any section of it made by a plane passing through its centre would be a circle, the circumference of which being conceived to be divided into 360 equal parts, called degrees, and the length of one of these measured, the whole circumference, and thence the diameter, of the earth, may be easily determined. For this purpose several mathematicians have undertaken the measurement of a degree on a meridian; and from the mean result of their several admeasurements, we may conclude that the circumference of the earth is

# MAP OF THE WORLD,




# IN TWO HEMISPHERES.

nearly 24869, and its mean diameter 7916, English miles; also that one degree contains about 69. 08 English miles, and that a nautical or geographical mile is equal to 6079 feet.

On comparison of the several admeasurements of a degree on a meridian, it was found they varied in different parts of the earth. This circumstance, together with others arising from the principle of gravity, led to the belief that its figure was not that of an exact sphere; and, in fact, it has been proved that the earth is flatted at the poles, similar to the figure of an orange, or rather that its form is that of an oblate spheroid, which is a solid, generated by the rotation of a semi-ellipsis about its shorter axis. It has likewise been established, that its polar and equatorial diameters are respectively 7898 and 7924 English miles, being nearly in the ratio of 304 to 305; but since its figure differs so little from that of a perfect sphere, it is usual, for the ease of calculation, to consider it of that form, which approaches sufficiently near the truth for almost all practical purposes, either in Navigation or Astronomy.

## OF THE NATURAL DIVISIONS OF THE EARTH.

The constituent parts of the earth are land and water: these naturally divide its surface into various portions, which have received the following particular terms, according to their size, shape, and situation.

A CONTINENT is a large tract of land comprehending several empires, kingdoms, or countries, not separated by any sea or ocean, as the Continents of Europe, Asia, Africa, and America.

An ISLAND is a portion of land entirely surrounded by water, as Great Britain and Ireland.

A PENINSULA is a part of land nearly encompassed with water, except where it is joined to a continent by a narrow neck or point of land; as the Morea in the Mediterranean Sea.

An ISTHMUS is the narrow neck of land joining a peninsula to the adjacent land, and forms a communication between them; as the Isthmus of Darien, which joins North and South America.

A PROMONTORY is a high part of land that projects into the sea, and is often called a CAPE when the land is high; and when it has but little elevation, it is more usually distinguished by the name of a POINT or HEAD. Thus the Cape of Good Hope is a mountainous promontory; and the Lizard, at the entrance to the English Channel, a point or headland.

An OCEAN is a vast collection of water, separating continents from each other, as the Atlantic and Pacific Oceans.

A SEA is a smaller collection of water, communicating with some adjacent ocean, and confined by land within a narrower space; as the Mediterranean and Baltic Seas. This term is sometimes used in a general sense for the whole body of salt water on the terraqueous globe.

A GULF is a part of the sea or ocean nearly surrounded by land, except where it immediately communicates with the sea; as the Gulf of Venice, in the Mediterranean; the Gulfs of Finland and Bothnia, in the Baltic Sea.

A BAY is such a gulf or inlet as does not run very deep into the land; as the Bay of Biscay, between the shores of France and Spain, and the Bay of Bengal, in the East Indies. Bays of a smaller description are frequently denominated CREEKS, HAVENS, or ROADS, though the last term is usually applied to places upon any coast where there is anchorage, and a certain degree of protection and shelter from winds.

A STRAIT is a narrow passage by which there is a communication between a gulf and the adjacent sea, or which joins one part of a sea or ocean with another; as the Strait of Gibraltar, which joins the Mediterranean Sea to the Atlantic Ocean.

A LAKE is a collection of water in an inland part, and, strictly considered, has no communication with the sea; as the Lake of Geneva. But this is not always attended to, for many of the loughs, or lakes, in Ireland and Scotland, and those in North America, as Lake Superior, Ontario, &c. are an exception.

## OF THE IMAGINARY DIVISIONS OF THE EARTH.

In order to point out the exact relative situation of places on the surface of the terraqueous globe, geographers are obliged to imagine certain points, lines, and circles belonging thereto, of which such as will more immediately enter under our consideration, we shall here explain.

The AXIS is an imaginary line passing through the centre of the earth. The extremities of this line are called the POLES: that which is nearest to us is called the *North Pole*, and its opposite the *South Pole*. The earth revolves round the axis, from west to east, in 24 hours, which causes the vicissitude of day and night.

The EQUATOR is a great circle on the earth equally distant from the Poles. It divides the earth into two equal parts, called HEMISPHERES; that having the North Pole in its centre, is called the *Northern Hemisphere*; and the other the *Southern Hemisphere*.

MERIDIANS are imaginary circles on the earth passing through both the Poles, crossing the equator at right angles, and dividing the globe into two parts, called the *Eastern* and *Western Hemispheres*; or rather, the meridian of a place is a semicircle passing through the place, and terminating at the Poles, the remaining half being called the *opposite Meridian*; hence every north and south line is part of a meridian.

It is usual for geographers to fix upon a meridian passing through some remarkable place, and to call it the *first Meridian*: thus, the British esteem that the first meridian which passes through the Royal Observatory at Greenwich; so the French reckon, for their first meridian, that which passes through the Royal Observatory at Paris; the Spaniards that which passes through Cadiz, and some geographers the meridian of Teneriffe. Hence it

appears the fixing of a first meridian is entirely arbitrary, most nations considering that the first meridian which passes through their capital, or principal observatory.

The HORIZON is that apparent circle which limits or bounds the view of a spectator on the sea, or on an extended plane, the eye being always supposed in the centre of the horizon. This circle is divided into 32 parts, called points, for a description of which see Mariner's Compass.

The earth is sometimes divided by certain circles, parallel to the equator, into portions, called ZONES; these are distinguished into two frigid, two temperate, and one torrid, in allusion to the general state of the air, with respect to heat and cold, which prevails in each of the situations.

The FRIGID ZONES are those regions about the Poles where the sun at certain times of the year does not rise or set for some days; they extend round the Poles as far as 23° 28′: the imaginary circle which bounds this limit in our northern hemisphere is called the *Arctic Polar Circle*, and that portion of the globe included within it, the *North Frigid Zone*. The circle which is at the same distance from the South Pole, in the southern hemisphere, is called the *Antarctic Polar Circle*, and the space between it and the Pole is termed the *South Frigid Zone*.

The TEMPERATE ZONES are those portions of the earth comprehended between the Polar Circles, and two parallel circles that are 23° 28′ distant from the equator: of these parallels, that in the northern hemisphere is called the *Tropic of Cancer;* and the other, in the southern hemisphere, the *Tropic of Capricorn*.

The TORRID ZONE is the space included between the two tropics, over every part of which the sun is vertical at some time of the year.

Besides these divisions into zones, the ancients divided the earth into CLIMATES, which are spaces contained between two parallels, where the difference in the longest day in each parallel is half an hour, as far as the Polar circles; and beyond that, where they differ by a month. They likewise distinguished the inhabitants by different names, according to the diversity of shadows of upright bodies at noon, and their relative situation with regard to each other; but these vague expressions, intended to give some general idea of the situation of different countries, have at length given way to the more precise terms of latitude and longitude.

## OF LATITUDE AND LONGITUDE.

The LATITUDE of a place is its distance from the equator, measured by an arch of a meridian contained between the equator and the given place: it is called either north or south, according as the given place is situated in the northern or southern hemisphere. Latitude is therefore reckoned from the equator towards the Poles, and never exceeds 90 degrees, that being the distance of the Poles from the equator. Hence a ship in north latitude sailing northerly, or in south latitude sailing southerly, increases

her latitude; but in north latitude sailing southerly, or in south latitude sailing northerly, she decreases her latitude.

The PARALLEL OF LATITUDE of any place is a circle passing through that place parallel to the equator.

The DIFFERENCE OF LATITUDE between any two places is an arch of a meridian, contained between the parallels of latitude of those places.

The LONGITUDE of a place is an arch of the equator comprehended between the first meridian and that meridian which passes through the given place. It is usual to reckon longitude from the first meridian, either east or west, according as the given place lies in the eastern or western hemispheres, until it meet at the opposite meridian: therefore the longitude of a place cannot exceed 180 degrees, or a semicircle. A ship in east longitude sailing easterly, or in west longitude sailing westerly, increases her longitude; but in east longitude sailing westerly, or in west longitude sailing easterly, she decreases her longitude.

The DIFFERENCE OF LONGITUDE between two places is an arch of the equator intercepted between the meridians of those places, and cannot exceed 180 degrees.

## PROBLEM I.

*To find the difference of Latitude between two Places.*

RULE. When the latitudes are both of the same name, that is, both north or both south, subtract the less from the greater, and the remainder will be the difference of latitude; but when one is north, and the other south, their sum will be the difference of latitude.

EXAMPLE I. What is the difference of latitude between the Lizard and Cape Finisterre?

| | | | |
|---|---|---|---|
| Latitude of the Lizard ... | 49° | 58′ | N. |
| Lat. of Cape Finisterre... | 42 | 56 | N. |
| Diff. of latitude ..... | 7 | 2 | |
| | 60 | | |
| In miles ..... | 422 | | |

EXAMPLE II. A ship from latitude 3° 10′ S. arrives to latitude 2° 26′ N.: required the difference of latitude made good.

| | | | |
|---|---|---|---|
| Latitude left..... | 3° | 10′ | S. |
| Latitude in ..... | 2 | 26 | N. |
| Diff. of latitude ..... | 5 | 36 | |
| | 60 | | |
| In miles..... | 336 | | |

## PROBLEM II.

*With the Latitude left, and the difference of Latitude, to find the Latitude in.*

RULE. When the latitude left, and difference of latitude, are of the same name, their sum gives the latitude in; but when they are of contrary names, their difference is the latitude in, of the same name with the greater.

EXAMPLE I. A ship from the West end of the Island of Madeira, in latitude 32° 49′ N., sails North 520 miles*: what latitude is she in?

| | | | |
|---|---|---|---|
| Latitude of Madeira ..... | 32° | 49′ | N. |
| Diff. of latitude 520 or... | 8 | 40 | N. |
| Latitude in..... | 41 | 29 | N. |

EXAMPLE II. A ship three days ago was in latitude 2° 48′ N., and has since then sailed South 426 miles: required her present latitude.

| | | | |
|---|---|---|---|
| Latitude left ..... | 2° | 48′ | N. |
| Diff. of latitude 426 or... | 7 | 6 | S. |
| Latitude in..... | 4 | 18 | S. |

## PROBLEM III.

### *To find the Difference of Longitude between two Places.*

RULE. If the longitudes of the given places be both east or both west, subtract the less from the greater; but if one be east, and the other west, add them together, and the sum or remainder will be the difference of longitude. When the sum of the two longitudes exceed 180 degrees, subtract it from 360 degrees, and the remainder will be the difference of longitude.

EXAMPLE I. What is the difference of longitude between the Lizard and St. Mary's, one of the Western Islands?

| | | | |
|---|---|---|---|
| Longitude of the Lizard | 5° | 11′ | W. |
| Longitude of St. Mary's | 25 | 13 | W. |
| Diff. of longitude... | 20 | 2 | |
| | 60 | | |
| In miles ..... | 1202 | | |

EXAMPLE II. A ship sailing Westward from North Cape, New Zealand, arrives at longitude 164° 47′ E.: required the diff. of longitude made good.

| | | | |
|---|---|---|---|
| Long. of North Cape ... | 173° | 10′ | W. |
| Long. of ship ..... | 164 | 47 | E. |
| Sum ..... | 337 | 57 | |
| | 360 | 0 | |
| Diff. of longitude... | 22 | 3 | |
| | 60 | | |
| In miles ..... | 1323 | | |

## PROBLEM IV.

### *With the Longitude left, and Difference of Longitude, to find the Longitude in.*

RULE. If the longitude left, and difference of longitude, be of contrary names, subtract the less from the greater, and the remainder will be the longitude in, of the same name with the greater; but if the longitude left, and difference of longitude, be of the same name, their sum will be the longitude in, of the same name with the longitude left: if this sum exceed 180°, subtract it from 360°, and the remainder will be the longitude in, of a contrary name to the longitude left.

* When the difference of latitude or longitude is given in miles, it is to be divided by 60, to reduce it to degrees and minutes.

EXAMPLE I. Suppose a ship from St. Helena sail eastward till her difference of longitude be 220 miles: required her longitude in.

| | | | |
|---|---|---|---|
| Long. of St. Helena ..... | 5° | 45′ | W. |
| Diff. of longitude 220 or... | 3 | 40 | E. |
| Longitude in ..... | 2 | 5 | W. |

EXAMPLE II. If a ship from longitude 176° 49′ W. sail westward till her difference of longitude be 10° 14′ W., what is her present longitude?

| | | | |
|---|---|---|---|
| Longitude left ..... | 176° | 49′ | W. |
| Diff. of longitude ..... | 10 | 14 | W. |
| Sum ..... | 187 | 3 | |
| | 360 | 0 | |
| Longitude in..... | 172 | 57 | E. |

## EXAMPLES FOR EXERCISE.

1. Required the difference of latitude and longitude between Ushant Island and Cape Ortegal.
Answer. Diff. of latitude 281 miles; diff. of longitude 168 miles.

2. What is the difference of latitude and longitude between the Cape of Good Hope and Cape Horn.
Answer. Diff. of latitude 1297 miles; diff. of longitude 5145 miles.

3. Required the difference of latitude and longitude between Cape Verde (paps) and Cape St. Roque.
Answer. Diff. of latitude 1211 miles; diff. of longitude 1066 miles.

4. Required the difference of latitude and longitude between Port Jackson, in New South Wales, and Karakakoa Bay in Owhyhee or Hawaii, one of the Sandwich Islands.
Answer. Diff. of latitude 3199 miles; diff. of longitude 3160 miles.

5. A ship from Funchal, in Madeira, sails in the S. E. quarter until her difference of latitude is 326 miles, and difference of longitude 425 miles: required her present latitude and longitude.
Answer. Latitude 27° 12′ N.; longitude 9° 51′ W.

6. A ship from latitude 2° 56′ S., and longitude 5° 14′ E., sails north-westerly till her difference of latitude is 352 miles, and difference of longitude 628 miles: required her present latitude and longitude.
Answer. Latitude 2° 56′ N.; longitude 5° 14′ W.

7. A ship from the Equator, and longitude 89° 17′ E., sails south-westerly till her difference of latitude is 370 miles, and difference of longitude 118 miles: required her present latitude and longitude.
Answer. Latitude 6° 10′ S.; longitude 87° 19′ E.

8. A ship from Cape East, in New Zealand, sails in the N. E. quarter till her difference of latitude is 114 miles, and difference of longitude 297 miles: required her present latitude and longitude.
Answer. Latitude 35° 51′ S., and longitude 176° 27′ W.

NOTE. The latitudes and longitudes of the given places are to be taken from Table LV.

# Description and Use of the LOG, HALF-MINUTE GLASS, AND COMPASS.

THE instruments used for estimating a ship's path or track at sea, are the log, half-minute glass, and compass.

## OF THE LOG AND HALF-MINUTE GLASS.

The common LOG is a flat piece of wood in the form of a quadrant, with a sufficient quantity of lead fixed to the circular edge to keep it steady, and in a perpendicular position on the surface of the water. To this is fastened a line about 120 fathoms long, called the LOG LINE, which is divided into spaces called KNOTS, and wound on a reel, from which it runs off freely when used.*

The HALF-MINUTE GLASS is of the same shape with an hour-glass, and contains such a quantity of sand as will run through the hole in its neck in half-a-minute of time.

The use of these instruments is to ascertain the velocity of a ship, or at what rate she sails, by an operation called *heaving the log*, which is performed in the following manner:—The reel being held by one man, and the half-minute glass by another, the officer of the watch throws the log over the ship's quarter on the lee side, which swimming perpendicularly, remains stationary; and when he observes the first mark is going over the ship's side, which is usually a red rag at the distance of 10 or 12 fathoms from the log (that quantity, called *stray line*, being allowed, in order to carry the log out of the eddy of the ship's wake), he gives notice to the man who holds the glass, to turn it; and as soon as the sand in the glass is run out, the line is immediately stopped; then, the number of knots and fathoms which had run off at the expiration of the glass, being considered as miles and parts, gives the distance the ship has run the preceding hour, if the wind has been constant: but if the gale has not been the same during the whole hour, or time between heaving the log, or if there has been more

* Several machines have been invented for measuring the distance run by a ship in a given time; but the best of these is *Massey's Patent Log*. This machine consists of two parts: the *Register*, containing a system of wheel-work connected with the fingers of three several indexes; and the *Rotator*, which is a hollow cylinder, made air-tight, with four vanes placed on it obliquely, and fastened by a cord, about six feet in length, to one end of the register. To a loop-hole at the other end of the register is secured another line, of sufficient length (30 to 50 fathoms) to keep the machine beyond the eddy of the ship's wake, which line is made fast to the vessel.

When the log is used, all the fingers of the indexes are set at 0, and both register and rotator committed to the water; as the vessel moves forward the log follows, and from the obliquity of the vanes, it is evident the rotator must revolve quicker or slower, correspondent to the ship's velocity. This rotatory motion is communicated by the cord to the wheel-work connected with the fingers of the indexes, by which means the actual space passed through in any given time is pointed out. This log has been in use several years, particularly in the Royal Navy.

sail set or handed, there must be an allowance made for it, according to the discretion of the officer. Sometimes, when the ship is before the wind, and a great sea setting after her, it will bring home the log; in such cases it is customary to allow one mile in ten, and less in proportion if the sea be not so great; a proper allowance ought also to be made if there be a head sea. In heaving the log, great care should be taken to veer out the line as fast as the log takes it; for if the log be left to turn the reel itself, it will come home, and give an erroneous distance.

When the ship is sailing several knots an hour, sometimes quarter-minute glasses are used, in which case the knots and fathoms run off the reel are to be doubled, to give the hourly rate.

In ships of war and East Indiamen, it is usual to heave the log once every hour; but in merchant ships only once every two hours.

The length of the log-line between each knot ought to be 51 feet nearly, that being the same part of a nautical mile that half-a-minute is of an hour*, *viz.* 120th part; but as the log is apt to be drawn after the vessel, and as it is safer to have the reckoning rather before than after the ship, 50 feet have been thought sufficient space between the knots, each of which contains 10 fathoms of 5 feet. Indeed it is usual to allow only 48 feet to a knot, that is, 8 fathoms of 6 feet each, and sometimes a less quantity, with which a glass is used running 28 seconds; but whatever may be the assigned length of the intervals between the knots, it is most convenient to divide them decimally, or into ten equal parts, by which the computation of the ship's run will be rendered more easy and accurate.

But both the log-line and half-minute glass are frequently affected by alterations in the heat or moisture of the weather; it therefore becomes necessary often to examine them, and if found erroneous, to correct the ship's run. The length of line between the knots may be easily ascertained by measuring them with a rule: and the half-minute glass may be examined either by a watch with seconds, or if that be not at hand, by the following method—fasten a plummet to a line, and hang it on a nail, observing that the distance between the nail and the middle of the plummet be 39¼ inches; then swing the plummet, and notice how often it passes under the nail while the glass is running out, and that will be the number of seconds measured by the glass.

The following rules for correcting the ship's run, on account of the errors in the log-line or half-minute glass, are given on a supposition that the knot ought to measure 50 feet, and the glass to run 30 seconds.

## CASE I.

### *When the Log-line is truly divided, and the Glass faulty.*

RULE. Multiply the distance given by the log by 30; divide the product by the seconds run by the glass, and the quotient will be the true distance.

---

* The length of a nautical mile is about 6079 English feet (see page 53): this divided by 120, gives 50 feet 8 inches for the length of a knot.

EXAMPLE I. If a ship sail 8 knots by the log, while the glass is running out, which when measured, is found to run 34 seconds, what is her true rate of sailing?

Distance by log 8 knots.
30

34)240(7 knots.
238

2

EXAMPLE II. Suppose the distance sailed by the log be 75 miles, and the glass run out in 27 seconds, what is the true distance run?

Distance by log 75 miles.
30

27)2250(83. 3 true distance
216 sailed.

90
81

90
81

9, &c.

## CASE II.

*When the Glass is true, and the Log-line faulty.*

RULE. Multiply the distance sailed by twice the measured length of a knot; then point off two figures to the right, and the remainder will be the true distance.

EXAMPLE I. A ship sails 9 knots in half-a-minute, by a log measuring 52 feet; required her true rate of sailing.

Distance by log..... 9 knots.
Twice the length of a knot 104

True rate ..... 9. 36 knots,
or 9 knots 4 fathoms nearly.

EXAMPLE II. If a ship sail 195 miles by a log which measures 48 feet, what is her true distance run?

Distance by log ..... 195 miles.
Twice the length of a knot 96

1170
1755

True distance.....187. 20 miles.

## CASE III.

*When the Glass and Log-line are both faulty.*

RULE. Multiply the distance sailed by the log, by six times the measured length of a knot, and divide the product by the seconds run by the glass; the quotient, pointing off one figure to the right, will be the true distance.

EXAMPLE I. If a ship run 5 knots of a log-line of 45 feet to a knot, while a glass of 25 seconds is running out, what is her true rate of sailing?

Distance run by log ..... 5
6 times the length of a knot $45 \times 6 = 270$

Seconds run by a glass ... 25) 135. 0

True rate of sailing ..... 5. 4
or 5 knots 4 fathoms.

EXAMPLE II. Suppose the distance sailed by the log be 150 miles, the measured length of a knot being 51 feet, and the glass running 28 seconds: required the true distance run.

Distance by log ..... 150 miles
6 times length of a knot . 306

28) 4590. 0

True distance run ..... 163. 9 miles.

*To find the Length of a Knot corresponding to a Glass running any given Number of Seconds.*

RULE. Add a cipher to the number of seconds run by the glass, and divide this by 6; the quotient will be the proportional length of a knot in feet.

EXAMPLE I. What ought to be the length of a knot when the glass runs 33 seconds?

6) 330

55 feet.

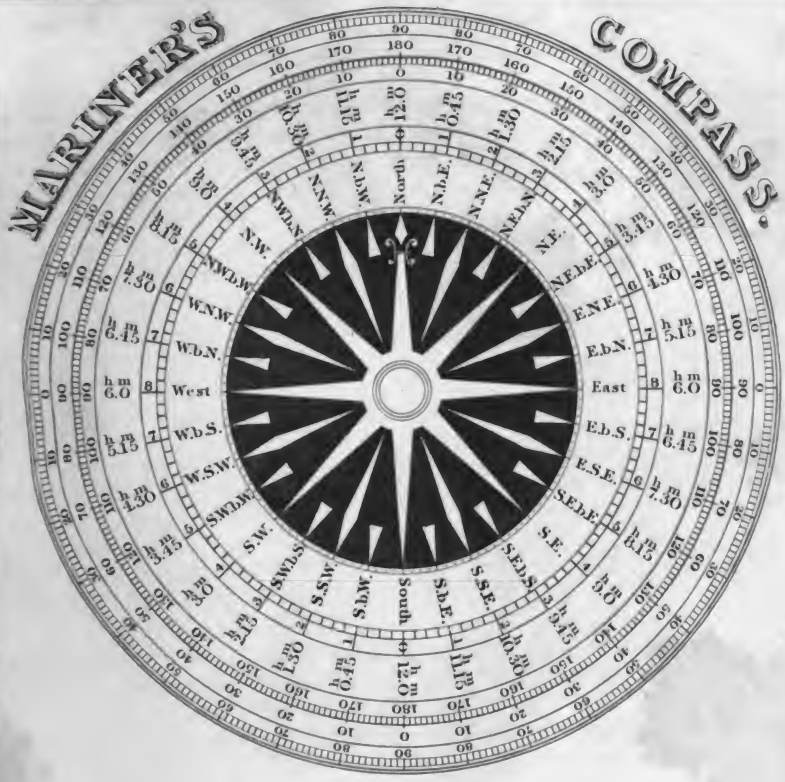
EXAMPLE II. Required the length of a knot corresponding to a glass that runs 28 seconds.

6) 280

46. 67 or 46 feet 8 in.

## OF THE MARINER'S COMPASS.

This instrument is an artificial representation of the horizon of any place. It consists of a circular card, divided into 32 equal parts, by lines drawn from the centre to the circumference, called RHUMB LINES, the extremities of which are termed POINTS or RHUMBS: the intervals are subdivided into halves and quarters, called HALF POINTS and QUARTER POINTS; the whole circumference is likewise divided into 360 degrees, consequently the angle comprehended between any two rhumbs is equal to 11 degrees 15 minutes. The four principal points are called the CARDINAL POINTS, two of which, opposite each other, are called the NORTH and SOUTH Points: that which is on the right hand, when we look towards the north, is termed the EAST, and its opposite the WEST Point; the names of the other points are compounded of these, according to their situation, but instead of the words, the initials only are inserted, as exhibited in Plate III., where there is also a Table, containing the measure of the angles that each point, and quarter point, makes with the north and south, or meridian line. Under the card, along the north and south line, a small bar of steel is fixed, called the NEEDLE, which being magnetized, or touched with a loadstone, acquires




## A TABLE OF THE ANGLES

which every Point & Quarter Point of the Compass makes with the Meridian.

| NORTH | | POINTS | ° ′ ″ | POINTS | SOUTH | |
|---|---|---|---|---|---|---|
| | | 0 – ¼ | 2 . 48 . 45 | 0 – ¼ | | |
| | | 0 – ½ | 5 . 37 . 30 | 0 – ½ | | |
| | | 0 – ¾ | 8 . 26 . 15 | 0 – ¾ | | |
| N.b.E. | N.b.W. | 1 | 11 . 15 . 0 | 1 | S.b.E. | S.b.W. |
| | | 1 – ¼ | 14 . 3 . 45 | 1 – ¼ | | |
| | | 1 – ½ | 16 . 52 . 30 | 1 – ½ | | |
| | | 1 – ¾ | 19 . 41 . 15 | 1 – ¾ | | |
| N.N.E. | N.N.W. | 2 | 22 . 30 . 0 | 2 | S.S.E. | S.S.W. |
| | | 2 – ¼ | 25 . 18 . 45 | 2 – ¼ | | |
| | | 2 – ½ | 28 . 7 . 30 | 2 – ½ | | |
| | | 2 – ¾ | 30 . 56 . 15 | 2 – ¾ | | |
| N.E.b.N. | N.W.b.N. | 3 | 33 . 45 . 0 | 3 | S.E.b.S. | S.W.b.S. |
| | | 3 – ¼ | 36 . 33 . 45 | 3 – ¼ | | |
| | | 3 – ½ | 39 . 22 . 30 | 3 – ½ | | |
| | | 3 – ¾ | 42 . 11 . 15 | 3 – ¾ | | |
| N.E. | N.W. | 4 | 45 . 0 . 0 | 4 | S.E. | S.W. |
| | | 4 – ¼ | 47 . 48 . 45 | 4 – ¼ | | |
| | | 4 – ½ | 50 . 37 . 30 | 4 – ½ | | |
| | | 4 – ¾ | 53 . 26 . 15 | 4 – ¾ | | |
| N.E.b.E. | N.W.b.W. | 5 | 56 . 15 . 0 | 5 | S.E.b.E. | S.W.b.W. |
| | | 5 – ¼ | 59 . 3 . 45 | 5 – ¼ | | |
| | | 5 – ½ | 61 . 52 . 30 | 5 – ½ | | |
| | | 5 – ¾ | 64 . 41 . 15 | 5 – ¾ | | |
| E.N.E. | W.N.W. | 6 | 67 . 30 . 0 | 6 | E.S.E. | W.S.W. |
| | | 6 – ¼ | 70 . 18 . 45 | 6 – ¼ | | |
| | | 6 – ½ | 73 . 7 . 30 | 6 – ½ | | |
| | | 6 – ¾ | 75 . 56 . 15 | 6 – ¾ | | |
| E.b.N. | W.b.N. | 7 | 78 . 45 . 0 | 7 | E.b.S. | W.b.S. |
| | | 7 – ¼ | 81 . 33 . 45 | 7 – ¼ | | |
| | | 7 – ½ | 84 . 22 . 30 | 7 – ½ | | |
| | | 7 – ¾ | 87 . 11 . 15 | 7 – ¾ | | |
| East. | West. | 8 | 90 . 0 . 0 | 8 | East. | West. |

J. Nerie delin.

the peculiar property of pointing north and south*, and consequently by the card determines the direction of the other points of the horizon. The needle, having a small socket in the centre, is supported, together with the card, on the point of a fine steel pin, on which it freely turns, and by the above-mentioned property its points keep always in the same direction: these are confined in a circular brass box with a glass cover, the box being hung in brass hoops or gimbals, in order to counteract the motion of the ship. The whole of these are placed in a square wooden box with a moveable lid, which serves to support the gimbals, and secure the compass from accident in removals.

The compass is used to point out the direction that a ship sails at sea. For this purpose, it is to be so placed in the ship that the middle section of the wooden box, parallel to its sides, may be parallel to the middle section of the ship along its keel. When it is thus fixed, that point of the card which coincides with a perpendicular line, marked in the inside of the circular box, and termed by seamen LUBBER'S POINT, will shew the direction of the ship's head.

The courses and distances which a ship sails in 24 hours are usually set down on a board, called the LOG BOARD, which will be further explained hereafter.

# PLANE SAILING.

PLANE SAILING is the art of navigating a ship upon principles deduced from the supposition of the earth being an extended plane. On this supposition, the meridians are considered as being all parallel to each other, the parallels of latitude at right angles to the meridians, and the length of a degree on the meridian, equator, and parallels of latitude, every where equal. In this sailing there are four principal parts, *viz.* the Course, Distance, Difference of Latitude, and Departure.

The COURSE is the angle which a ship's track or path makes with the meridian, and is expressed either in points or degrees. Thus, when a ship sails in a north-east direction, we say her course is 4 points, or 45 degrees.

The DISTANCE is the number of miles, &c. between any two places reckoned on the rhumb line of the course; or it is the length that a ship has sailed on a direct course in a given time.

* This is not strictly true, for the needle deviates more or less from the north and south points of the horizon, at different places, and at different times; but as the methods by which this deviation of the needle is found, depend on astronomical observations, we shall defer entering into a further explanation till we treat on that subject.

The DIFFERENCE OF LATITUDE is the distance which a ship has made north or south of the place sailed from, and is reckoned on a meridian.

The DEPARTURE is the east or west distance a ship has made from the meridian of the place she departed from, and is reckoned on a parallel of latitude.

Hence it is evident that if a ship sail due north or south, she sails on a meridian, makes no departure, and her distance and difference of latitude are the same. If a ship sail due east or west, she runs on a parallel of latitude, makes no difference of latitude, and her departure and distance are the same; but when a ship sails in any other direction, she makes both difference of latitude and departure, and these, with the distance, form a right-angled triangle, the hypothenuse of which is the distance sailed, the perpendicular is the difference of latitude, the base the departure, the angle opposite the base is the course, and that opposite the perpendicular the complement of the course: hence, any two of these parts being given, the rest may be found by Plane Trigonometry.

When a ship's course is 4 points, or 45 degrees, the difference of latitude and departure are equal; when the course is less than 4 points, or 45 degrees, the difference of latitude is greater than the departure; when the course is more than 4 points, or 45 degrees, the departure is greater than the difference of latitude.

In constructing a figure relating to a ship's course, let the upper part of what the figure is drawn on represent the north, then the lower part will be the south, the right hand east, and the left west.

Draw a north and south line, to represent the meridian of the place the ship sailed from; then if the ship's course be to the southward, mark the upper end of the line for the place sailed from; but if the course be northward, mark the lower end for that place.

Through the point sailed from draw a line, making a right angle with the meridian line (Prob. XII. Geom.) on the east or west side, according as the ship is sailing to the eastward or westward; and that line will represent the parallel of the place the ship sailed from.

When the course is given, it is to be laid off from the meridian on the arch described in making the right angle, taken either from the line of chords or rhumbs, according as it is given in degrees or points.

A line drawn from the centre of the quadrant, through the point laid off for the course, will represent the distance, which, if given, is to be laid thereon, beginning at the point sailed from. A line drawn from the extremity of the distance, parallel to the east or west line, will determine the difference of latitude and departure.

If the difference of latitude be given, it is to be laid upon the meridian, beginning at the point representing the place the ship left; and a line drawn from the extremity of the difference of latitude, parallel to the east or west line, till it meet the distance produced, will form the figure.

If the departure be given, it is to be drawn parallel to the east or west line, through the extremity of the difference of latitude or distance.

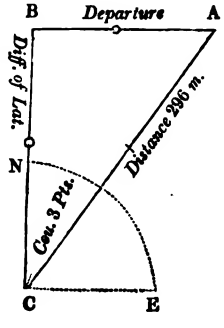
## CASE I.

### *The Course and Distance given, to find the Difference of Latitude and Departure.*

EXAMPLE. A ship from latitude 48° 40′ N., sails N. E. by N. 296 miles: required her present latitude, and the departure made good.

BY CONSTRUCTION.

Draw the line B C to represent the meridian the ship sailed from; with the chord of 60° in the compasses, and one foot in C, describe the arch N E; from N to E lay off the chord of 90°, and draw the line C E: then will N C E represent the N. E. quarter of the compass. Take the course three points in the compasses from the line of rhumbs, which lay off from N towards E, and through the point where it cuts the arch draw the line C A, which make equal to the distance 296, taken from a scale of equal parts; through A draw the line B A parallel to C E (Prob. IV. Geom.); then will B A represent the departure equal to 164. 4 miles, and C B the difference of latitude 246 miles.




BY CALCULATION.

| *To find the Departure.* | | *To find the Difference of Latitude.* | |
|---|---|---|---|
| As radius | 10. 00000 | As radius | 10. 00000 |
| Is to distance 296 | 2. 47129 | Is to distance 296 | 2. 47129 |
| So is sine of course 3 pts.* | 9. 74474 | So is co. sine of course 3 pts. | 9. 91985 |
| | 12. 21603 | | 12. 39114 |
| | 10. 00000 | | 10. 00000 |
| To the departure 164. 4 | 2. 21603 | To the diff. of latitude 246. 1 | 2. 39114 |

*To find the Latitude in.*

| | | |
|---|---|---|
| Latitude left | 48° 40′ | N. |
| Diff. of latitude 246 miles, or | 4 6 | N. |
| Latitude in | 52 46 | N. |

* The course being given in points, the logarithm of its sine, &c. is to be taken from Table XXIII.

### BY INSPECTION.*

Enter the first Traverse Table, and find the course 3 points at the top, and in one of the columns marked *dist.* find the distance 296; then opposite to this, in the columns marked *lat.* and *dep.*, will be the difference of latitude 246. 1, and the departure 164. 4.

### BY GUNTER'S SCALE.

Extend from radius, or 8 points, to the course 3 points on the line of sine rhumbs, marked S. R.; that extent will reach from the distance 296, to the departure 164. 4 on the line of numbers.

Extend from radius, or 8 points, to the complement of the course 5 points on the line of sine rhumbs; that extent will reach from the distance 296, to the difference of latitude 246. 1 on the line of numbers.

## CASE II.

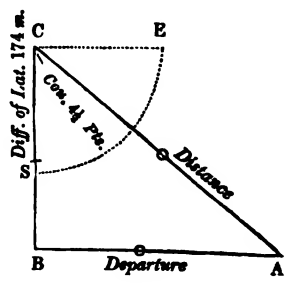
### *The Course and Difference of Latitude given, to find the Distance and Departure.*

EXAMPLE. A ship sails S. E. ½ E. from St. Helena, in latitude 15° 55′ S., until by observation she is in latitude 18° 49′ S.: required her distance run, and departure made good.

| | | |
|---|---|---|
| Latitude of St. Helena | 15° | 55′ S. |
| Latitude come to ..... | 18 | 49 S. |
| Difference of latitude... | 2 | 54 = 174 miles. |

### BY CONSTRUCTION.

Draw the meridian line C B, which make equal to the difference of latitude 174; from C, with the chord of 60°, describe the arch S E, on which lay off 90°, and draw the line C E; from S towards E lay off the course 4½ points, taken from the line of rhumbs, and through the point where it cuts the arch S E draw the line C A; from B draw the line B A parallel to the line C E; then will the departure B A measure 212, and the distance C A 274. 3 miles.




* Previous to resolving the Cases by this method, it will be necessary for the learner to read attentively the Explanation to Tables I. and II., which are constructed by this Case for every point, quarter-point, and degree of the compass, to distances not exceeding 300.

## BY CALCULATION.

| *To find the Departure.* | | *To find the Distance.* | |
|---|---|---|---|
| As co. sine of course 4½ pts. | 9. 80236 | As co. sine of course 4½ pts. | 9. 80236 |
| Is to diff. of latitude 174 | 2. 24055 | Is to diff. of latitude 174 | 2. 24055 |
| So is sine of course 4½ pts. | 9. 88818 | So is radius | 10. 00000 |
| | 12. 12873 | | 12. 24055 |
| | 9. 80236 | | 9. 80236 |
| To the departure 212 | 2. 32637 | To the distance 274. 3 | 2. 43819 |

## BY INSPECTION.

Over the course 4½ points, find the difference of latitude 174 (or the nearest to it, which is 173. 8) in a *lat.* column, opposite to which will be found the departure 211. 8, and the distance 274, in their respective columns.

## BY GUNTER'S SCALE.

Extend from the complement of the course 3½ points, to the course 4½ points on the line of sine rhumbs; that extent will reach from the difference of latitude 174 to the departure 212 on the line of numbers.

Extend from the complement of the course 3½ points, to radius, or 8 points, on the line of sine rhumbs; that extent will reach from the difference of latitude 174 to the distance 274. 3 on the line of numbers.

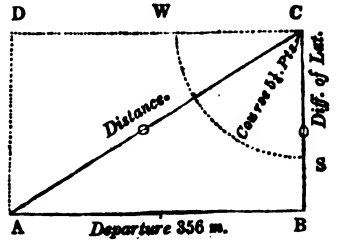
# CASE III.

### *The Course and Departure given, to find the Difference of Latitude and Distance.*

EXAMPLE. A ship from latitude 3° 16′ N., sails S. W. by W. ¼ W., until she has made 356 miles of departure: required her present latitude, and distance sailed.

## BY CONSTRUCTION.

Draw the meridian line C B, and describe the quadrant C W S to represent the S. W. quarter of the compass; from S towards W lay off the course 5¼ points, and through the point where it cuts the arch S W draw the line C A; from C to D lay off the departure 356, and through D draw the line D A parallel to C B, meeting the line C A in A; through A draw the line A B parallel to D C, meeting C B in B: then will the difference of latitude C B measure 213. 4, and the distance A C 415. 1.



BY CALCULATION.

| *To find the Difference of Latitude.* | | *To find the Distance.* | |
|---|---|---|---|
| As sine of course 5¼ pts. | 9. 93335 | As sine of course 5¼ pts. | 9. 93335 |
| Is to departure 356 | 2. 55145 | Is to departure 356 | 2. 55145 |
| So is co. sine of course 5¼ pts. | 9. 71105 | So is radius | 10. 00000 |
| | 12. 26250 | | 12. 55145 |
| | 9. 93335 | | 9. 93335 |
| To the diff. of latitude 213. 4 | 2. 32915 | To the distance 415. 1 | 2. 61810 |

*To find the Latitude in.*

| | | | |
|---|---|---|---|
| Latitude left..... | 3° | 16′ | N. |
| Diff. of latitude 213 miles, or | 3 | 33 | S. |
| Latitude in ..... | 0 | 17 | S. |

BY INSPECTION.

In that page of the Traverse Table marked with the course 5¼ points at the bottom, find half the given departure, *viz.* 178 (the whole being too great) in the *dep.* column; opposite to which, in the *lat.* and *dist.* columns, will be 106. 9 and 208; these being multiplied by 2, give the whole difference of latitude 213. 8, and the distance 416 miles.

BY GUNTER'S SCALE.

Extend from the course 5¼ points to the complement of the course 2¾ points on the line of sine rhumbs; that extent will reach from the departure 356 to the difference of latitude 213. 4 on the line of numbers.

Extend from the course 5¼ points to 8 points on the line of sine rhumbs; that extent will reach from the departure 356 to the distance 415. 1 on the line of numbers.

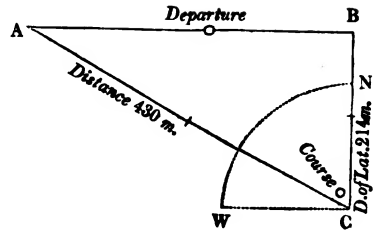
## CASE IV.

*The Distance and Difference of Latitude given, to find the Course and Departure.*

EXAMPLE. A ship from Cape St. Vincent, in latitude 37° 3′ N., sails between the north and west 430 miles, until her difference of latitude is 214 miles: required her course steered, and departure made good.

BY CONSTRUCTION.

Draw the quadrant N C W to represent the N. W. quarter of the compass, and from C to B lay off the difference of latitude 214; through B draw the line A B parallel to C W; with the distance 430 in the compasses, place one foot in C, and let the other foot cross A B in A, and draw the line A C: then will the course B C A measure 60 degrees, and the departure A B 373.




BY CALCULATION.

| *To find the Course.* | | *To find the Departure.* | |
|---|---|---|---|
| As the distance 430 | 2. 63347 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to distance 430 | 2. 63347 |
| So is the diff. of lat. 214 | 2. 33041 | So is sine of course 60° 9′ | 9. 93819 |
| | 12. 33041 | | 12. 57166 |
| | 2. 63347 | | 10. 00000 |
| To co. sine of course 60° 9′ | 9. 69694 | To the departure 373 | 2. 57166 |

BY INSPECTION.

Seek in the several pages of the Traverse Tables until half the distance 215, and half the difference of latitude 107, are found opposite each other in their respective columns; against these will be found 186. 2, which being doubled, gives the whole departure 372. 4: and as the column where the difference of latitude is found, is marked *lat.* at bottom, the course is to be taken from thence, which in this example is 60 degrees.

BY GUNTER'S SCALE.

Extend from the distance 430 to the difference of latitude 214 on the line of numbers; that extent will reach from radius, or 90°, to 29° 51′, the complement of the course on the line of sines: hence the course is 60° 9′.

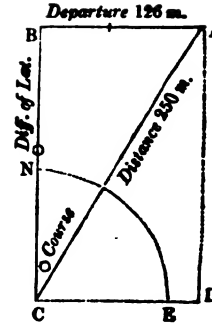
Extend from radius, or 90°, to the course 60° 9′ on the line of sines; that extent will reach from the distance 430 to the departure 373 on the line of numbers.

## CASE V.

*The Distance and Departure given, to find the Course and Difference of Latitude.*

EXAMPLE. A ship from latitude 1° 32′ S. sails between the north and east 250 miles, and finds she has made 126 miles of departure: required the course steered, and her latitude in.

### BY CONSTRUCTION.




Draw the quadrant N C E to represent the N. E. quarter of the compass; from C to D lay off the departure 126, and through D draw the line D A parallel to C N produced; with the distance 250 in the compasses, place one foot in C, and let the other cut D A in A; draw the line A C, and through A draw the line B A parallel to C D; then the course B C A will measure 30° 16′, and the difference of latitude C B 215. 9.

### BY CALCULATION.

| *To find the Course.* | | *To find the Difference of Latitude.* | |
|---|---|---|---|
| As the distance 250 | 2. 39794 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to the distance 250 | 2. 39794 |
| So is the departure 126 | 2. 10037 | So is co. sine of course 30°16′ | 9. 93636 |
| | 12. 10037 | | 12. 33430 |
| | 2. 39794 | | 10. 00000 |
| To sine of course 30° 16′ | 9. 70243 | To the diff. of lat. 215. 9 | 2. 33430 |

*To find the Latitude in.*

| | | |
|---|---|---|
| Latitude left..... | 1° 32′ | S. |
| Diff. of lat. 215. 9 miles, or | 3 36 | N. |
| Latitude in ..... | 2 4 | N. |

### BY INSPECTION.

Seek in the Tables till opposite the distance 250, taken in its column; the nearest to the given departure 126 is found in its proper column, adjoining to which stands the difference of latitude 216. 5; and as the column in which the departure is found, is marked *dep.* at the top of the page, the course is to be taken from thence, which therefore will be 30 degrees.

### BY GUNTER'S SCALE.

Extend from the distance 250 to the departure 126 on the line of numbers; that extent will reach from radius, or 90°, to the course 30° 16′ on the line of sines.

Extend from radius, or 90°, to the complement of the course 59° 44′ on the line of sines; that extent will reach from the distance 250 to the difference of latitude 216 on the line of numbers.

## CASE VI.

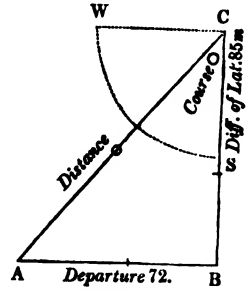
### *The Difference of Latitude and Departure given, to find the Course and Distance.*

EXAMPLE. A ship from Funchal, in Madeira, in latitude 32° 38′ N., sails a direct course between the south and west until she is in latitude 31° 13′ N. by observation, having made 72 miles of departure: required her course steered, and distance run.

| | | |
|---|---|---|
| Latitude of Funchal ..... | 32° | 38′ N. |
| Latitude in by observation | 31 | 13 N. |
| Difference of latitude ..... | 1 | 25 = 85 miles. |

BY CONSTRUCTION.

Draw the meridian line C B, and from C describe the quadrant C S W; from C to B lay off the difference of latitude 85; through B draw A B parallel to C W, and equal to the departure 72, and join A C: then the course A C B will measure 40° 16′, and the distance A C 111. 4.




BY CALCULATION.

| *To find the Course.* | | *To find the Distance.* | |
|---|---|---|---|
| As the diff. of latitude 85 | 1. 92942 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to the diff. of latitude 85 | 1. 92942 |
| So is the departure 72 | 1. 85733 | So is sec. of course 40° 16′ | 10. 11745 |
| | 11. 85733 | | 12. 04687 |
| | 1. 92942 | | 10. 00000 |
| To tang. of course 40° 16′ | 9. 92791 | To the distance 111. 4 | 2. 04687 |

BY INSPECTION.

Seek in the different pages of the Tables till the difference of latitude 85, and the departure 72, or the nearest thereto, are found together in their respective columns, which will be under the course 40 degrees; and the distance answering to these will be 111.

NOTE. In this case, always seek for the larger of the two given numbers in the column marked *lat.* at the top of the page, until the smaller be found opposite to it in the column marked *dep.* at the top; observing, that when the departure is more than the difference of latitude, the course will be at the bottom of the page.

### BY GUNTER'S SCALE.

Extend from the difference of latitude 85 to the departure 72 on the line of numbers; that extent will reach from radius, or 45°, to the course 40° 16′ on the line of tangents.

Extend from the complement of the course 49° 44′ to 90° on the line of sines; that extent will reach from the difference of latitude 85 to the distance 111. 4 on the line of numbers.

### EXAMPLES FOR EXERCISE.

1. A ship from latitude 36° 30′ N., sails S. W. by W. 420 miles: what is her present latitude, and what departure has she made?
Answer. Latitude in 32° 37′ N., and departure 349. 3 miles.

2. A ship from latitude 3° 54′ S., has sailed N. W. ¾ W. till she arrives at latitude 2° 14′ N.: required her distance run, and departure made good.
Answer. Distance 617. 8, and departure 496. 2 miles.

3. A ship from St. Helena, in latitude 15° 55′ S., sails S. S. E. ½ E. till she has made 115 miles of departure: I demand her present latitude, and the distance she has run.
Answer. Latitude in 19° 30′ S., and distance 244 miles.

4. A ship from latitude 28° 20′ N., sails north-easterly 486 miles, and finds by observation that she is in latitude 32° 17′ N.: what course has she steered, and what departure has she made?
Answer. Course N. 60° 49′ E., or N. E. b. E. ½ E. nearly, and departure 424. 3 miles.

5. A ship sails between the north and west 170 leagues from a port, in latitude 38° 42′ N., until her departure is 98 leagues: required her course and latitude in.
Answer. Course N. 35° 12′ W., or N. W. b. N. ¼ W. nearly, and latitude in 45° 39′ N.

6. A ship from the Lizard, in latitude 49° 58′ N., sails to the westward on a direct course, till she arrives at latitude 48° 11′ N., and finds she has made 87 miles of westing: required her course steered, and distance run.
Answer. Course S. 39° 7′ W., or S. W. b. S. ½ W. nearly, and distance 137. 9 miles.

7. A ship from Ascension Island, in latitude 7° 56′ S., sails N. N. W. ½ W. 244 miles: required her present latitude, and departure made good.
Answer. Latitude in 4° 27′ S., and departure 125. 4 miles.

8. A ship from Cape St. Vincent, in latitude 37° 3′ N., sails between the south and west, till her difference of latitude is 69 miles, and her departure 215 miles: required her course, distance, and latitude in.
Answer. Course S. 72° 12′ W., or W. S. W. ½ W. nearly, distance 225. 7 miles, and latitude 35° 54′ N.

9. A ship from the Lizard, in latitude 49° 58′ N., sails 456 miles to the westward, and then finds she is 360 miles to the southward of the Lizard: required her course, departure, and latitude in.

Answer. Course S. 37° 52′ W., or S. W. ¾ S. nearly; departure 279. 9 miles, and latitude in 43° 58′ N.

10. A ship from Cape Hatteras, in latitude 35° 15′ N., sails in the north-east quarter 226 miles, and then finds that she is 198 miles to the eastward of the Cape: required her course, and latitude in.

Answer. Course N. 61° 11′ E., or N. E. by E. ¼ E., and latitude in 37° 4′ N.

11. If a ship take her departure, at 6h. P. M., from Cape Verd, in latitude 14° 45′ N., and sail W. S. W. ½ W. at the rate of 7 miles an hour until the next day at noon; what will be her distance run, departure, and latitude in?

Answer. Distance 126 miles, departure 120. 6, and latitude in 14° 8′ N.

12. A ship from latitude 55° 30′ N., sails S. W. by S. during 20 hours, and then finds by observation she is in latitude 53° 17′ N.: required her rate of sailing per hour, and the departure she has made.

Answer. Departure 88. 87 miles, distance run in 20 hours 160 miles, and therefore her rate per hour 8 miles.

## TRAVERSE SAILING.

WHEN a ship, either from contrary winds or other causes, is obliged to sail on different courses, the irregular or zigzag track she makes is called a TRAVERSE, or COMPOUND COURSE; and the method of reducing these several courses and distances into a single course and distance, is called resolving a traverse.

To resolve a traverse, make a Table (as that in Example I.), and divide it into six columns; in the first of these set down the several courses, and opposite to them, in the second column, their corresponding distances: the third and fourth columns are to be marked N. S. at the top, and are to contain the differences of latitude; the fifth and sixth are to be marked E. W., to contain the departures.

Find the difference of latitude and departure corresponding to each course and distance, by any of the methods in Case I. of Plane Sailing, the most common of which is that by Inspection; set these down opposite the distance in their proper columns, observing that the difference of latitude must be placed in the north column, if the course be northerly, and in the south column, if the course be southerly; and that the departure must be placed in the east column, if the course be easterly, and in the west column, if it be westerly. When the course is due north, south, east, or west, set down the distance in that column answering to it. Add up the columns of

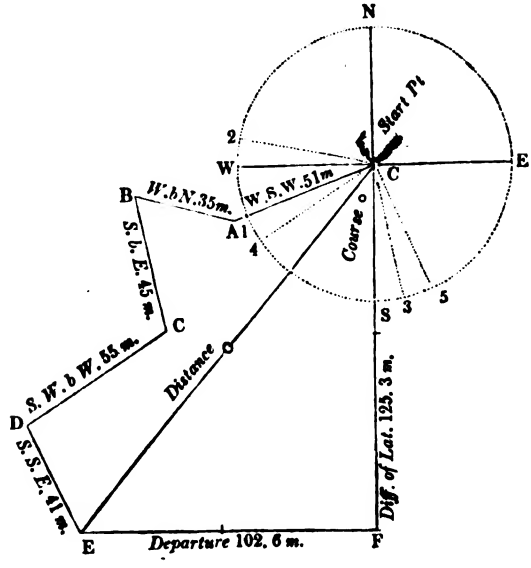
northing, southing, easting, and westing, and set down the sum of each at the bottom; then the difference between the sums of the north and south columns will be the whole difference of latitude made good, of the same name with the greater; and the difference between the sums of the east and west columns is the whole departure made good, of the same name with the greater sum.

With this whole difference of latitude and departure made good, find the direct course and distance, as in Case VI. of Plane Sailing.

## EXAMPLE I.

Suppose a ship from the Start, in latitude 50° 13′ N., sail W. S. W. 51 miles, W. b. N. 35 miles, S. b. E. 45 miles, S. W. b. W. 55 miles, and S. S. E. 41 miles: required her direct course and distance sailed, and her latitude in.

### BY CONSTRUCTION.




With the chord of 60° describe the circle N E S W, to represent the compass; draw the diameters N S and E W at right angles, the one representing the meridian, and the other the parallel the ship sailed from: take each course from the line of rhumbs, and lay them off from the meridian in their respective quarters, and number them in order 1, 2, 3, 4, &c.; thus, from S. to 1 lay off 6 points for the first course W. S. W.; from N. to 2 lay off 7 points for the second course W. b. N.; from S. to 3 lay off one point for the third course S. by E.; from S. to 4 lay off 5 points

for the fourth course S. W. b. W.; from S. to 5 lay off 2 points for the fifth course S. S. E.; and from the centre of the circle draw rhumb lines to each of these points, which may be produced to any length that is necessary. Upon the first rhumb C 1, lay off the first distance 51 miles, from C to A; then will A represent the ship's place at the end of the first course; through A draw A B parallel to the second course C 2 (Prob. IV. Geom.), and make it equal to the second distance 35 miles; through B draw B C parallel to C 3, and equal to 45 miles: through C draw C D parallel to C 4, and equal to 55 miles; and through D draw D E parallel to C 5, and equal to 41 miles. Through E draw the line E F parallel to the east and west line W E, meeting N S produced in F, and join C E. Then will C F be the difference of latitude made good, measuring 125. 3; E F the departure 102. 6, C E the distance 162, and the angle E C F the course 39° 19′, or 3½ points.

## TRAVERSE TABLE.

| Courses. | Dist. | Diff. of Lat. | | Departure. | |
|---|---|---|---|---|---|
| | | N. | S. | E. | W. |
| W. S. W. | 51 | | 19. 5 | | 47. 1 |
| W. b. N. | 35 | 6. 8 | | | 34. 3 |
| S. b. E. | 45 | | 44. 1 | 8. 8 | |
| S. W. b. W. | 55 | | 30. 6 | | 45. 7 |
| S. S. E. | 41 | | 37. 9 | 15. 7 | |
| | | 6. 8 | 132. 1 | 24. 5 | 127. 1 |
| | | | 6. 8 | | 24. 5 |
| | Diff. of Lat. | | 125. 3 | Dep. | 102. 6 |

Lat. left..... 50° 13′ N.
Diff. of Lat. 125 or 2 5 S.
Latitude in ..... 48 8 N.

*To find the Course and Distance made good.*

### BY CALCULATION.

*To find the Course.*

| | |
|---|---|
| As diff. of lat. 125. 3 | 2. 09795 |
| Is to radius | 10. 00000 |
| So is departure 102. 6 | 2. 01115 |
| | 12. 01115 |
| | 2. 09795 |
| To tang. course 39° 19′ | 9. 91320 |

*To find the Distance.*

| | |
|---|---|
| As radius | 10. 00000 |
| Is to diff. of latitude 125. 3 | 2. 09795 |
| So is sec. of course 39° 19′ | 10. 11145 |
| | 12. 20940 |
| | 10. 00000 |
| To the distance 162 | 2. 20940 |

Hence the direct course made good is S. 39° 19′ W. or S. W. b. S. ½ W., and the distance 162 miles.

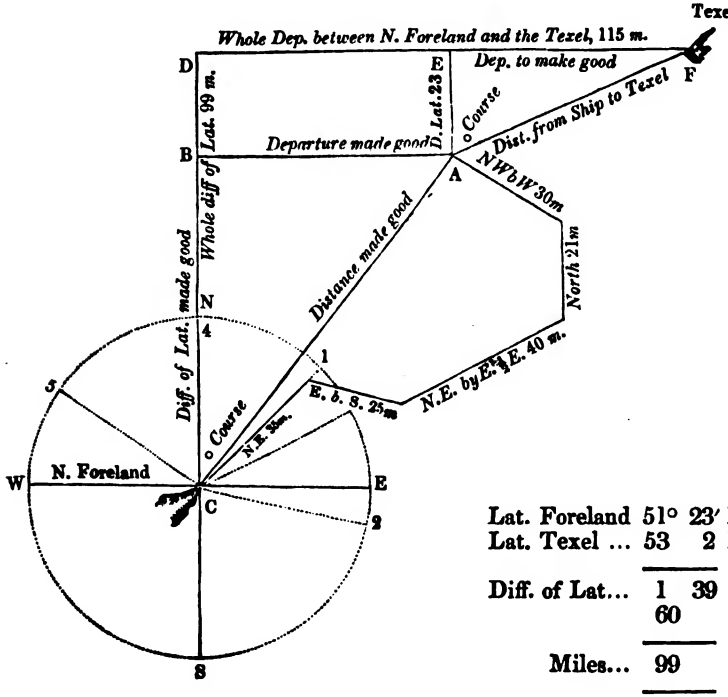
### BY INSPECTION.

Seek in the Traverse Table till the difference of latitude 125. 3, and departure 102. 6, are found opposite each other in their respective columns; the nearest to these will be 125. 2 and 102. 8, which give the course 3½ points at the top, and the distance 162 in its column.

### EXAMPLE II.

A ship from the North Foreland, in latitude 51° 23′ N., and bound to the Texel, which lies in latitude 53° 2′ N., and 115 miles to the eastward, sails N. E. 35 miles, E. b. S. 25 miles, N. E. b. E. ½ E. 40 miles, North 21 miles, and N. W. b. W. 30 miles: required her course and distance made good, the latitude she is in, and departure from the meridian; also the direct course and distance from the ship to the Texel.

### BY CONSTRUCTION.




| | | |
|---|---|---|
| Lat. Foreland | 51° | 23′ N. |
| Lat. Texel ... | 53 | 2 N. |
| Diff. of Lat... | 1 | 39 |
| | 60 | |
| Miles... | 99 | |

With the chord of 60° describe a circle, through the centre of which draw the north and south, or meridian line, N. S., and at right angles to it the east and west line, W. E.; lay off from the meridian, upon the circumference of the circle, the several courses in their proper quarters, number them in order, and draw a rhumb line from the centre to each of the points; then,

on the first rhumb line, which is N. E. or 4 points, lay off the distance 35 from the centre, and through the end of this first distance draw a line parallel to the second rhumb, E. b. S. 7 points, on which lay off the second distance 25; proceed thus till all the courses and distances are laid off, and through the end of the last distance draw the line A B parallel to the line W. E., meeting S. N. produced in B; then will A represent the ship's place, C B will measure the difference of latitude made good 76. 4, B A the departure 59. 6, C A the distance run 6. 91, and the angle B C A the course steered, 37° 58′

To find what course the ship must steer, and what distance she must run, before she can arrive at the Texel, lay off from C to D 99, the whole difference of latitude between the Foreland and the Texel, and through D draw D F parallel to W. E., and equal to the whole departure 115, then will F represent the situation of the Texel: through A draw A E parallel to C D, and join A F; then A E will be the northing, or difference of latitude 23, and E F the easting, or departure 55. 4, the ship has to make good; A F the distance the ship has to sail 60, and the angle E A F measuring 67° 27′, the course from the ship to the Texel.

## TRAVERSE TABLE.

| Courses. | Distance. | Diff. of Latitude. | | Departure. | |
|---|---|---|---|---|---|
| | | N. | S. | E. | W. |
| N. E. | 35 | 24. 7 | | 24. 7 | |
| E. b. S. | 25 | | 4. 9 | 24. 5 | |
| N. E. b. E. ½ E. | 40 | 18. 9 | | 35. 3 | |
| North | 21 | 21. 0 | | | |
| N. W. b. W. | 30 | 16. 7 | | | 24. 9 |
| | | 81. 3 | 4. 9 | 84. 5 | 24. 9 |
| | | 4. 9 | | 24. 9 | |
| | Diff. of Lat. | 76. 4 | Dep. | 59. 6 | |

### *To find the Course and Distance made good.*

BY CALCULATION.

| *To find the Course.* | | *To find the Distance.* | |
|---|---|---|---|
| As diff. of latitude 76. 4 | 1. 88309 | As radius | 10. 00000 |
| Is to radius | 10. 00000 | Is to diff. latitude 76. 4 | 1. 88309 |
| So is departure 59. 6 | 1. 77525 | So is sec. course 37° 58′ | 10. 10327 |
| | 11. 77525 | | 11. 98636 |
| | 1. 88309 | | 10. 00000 |
| To tang. course 37° 58′ | 9. 89216 | To the distance 96. 91 | 1. 98636 |

### BY INSPECTION.

The difference of latitude 76. 4, and departure 59. 6, being looked for till they are found opposite each other in their respective columns, give the course 38°, and the distance 97 miles.

*To find the direct Course and Distance from the Ship to the Texel.*

| | | | | | |
|---|---|---|---|---|---|
| Latitude of N. Foreland ... | 51° | 23′ N. | Whole departure ..... | 115m. | E. |
| Diff. of lat. made good, 76m. or | 1 | 16 N. | Departure made good ..... | 59.6 | E. |
| Latitude in ..... | 52 | 39 N. | Departure to make good ... | 55.4 | E. |
| Latitude of Texel ..... | 53 | 2 N. | | | |
| Diff. of latitude to make good | 0 | 23 N. | | | |

### BY CALCULATION.

*To find the Course.*

| | |
|---|---|
| As the diff. of latitude 23 | 1.36173 |
| Is to radius | 10.00000 |
| So is departure 55. 4 | 1.74351 |
| | 11.74351 |
| | 1.36173 |
| To tang. course 67° 27′ | 10.38178 |

*To find the Distance.*

| | |
|---|---|
| As radius | 10.00000 |
| Is to diff. of latitude 23 | 1.36173 |
| So is sec. course 67° 27′ | 10.41625 |
| | 11.77798 |
| | 10.00000 |
| To the distance 59. 98 | 1.77798 |

### BY INSPECTION.

The departure 55. 4, and difference of latitude 23, being looked for in the Tables till they are found together, the nearest numbers answering to them will be over the course 6 points, and opposite the distance 60 miles.

### EXAMPLES FOR EXERCISE.

1. A ship from the Lizard, in latitude 49° 58′ N., sails as follows: S. by W. 42 miles, W. S. W. 36 miles, West 18 miles, E. S. E. 22 miles, South 34 miles, and N. E. 21 miles: required her present latitude, and the direct course and distance made good.

Answer. Her latitude in is 48° 35′ N., the course made good, S. 16° 27′ W., or S. by W. ½ W. nearly, and the distance 86. 13 miles.

2. A ship from latitude 9° 26′ N. sails N. E. 20 miles, North 33 miles, N. N. W. 15 miles, East 25 miles, N. E. by N. 42 miles, and S. W. ½ W. 28 miles: required her course and distance made good, and her present latitude.

Answer. Course N. 24° 12′ E., or N. N. E. ¼ E. nearly; distance 85. 63 miles, and present latitude 10° 44′ N.

3. A ship from the Cape of Good Hope, in latitude 34° 22′ S., sails S. W. ½ S. 27 miles, S. E. by E. 45 miles, S. W. by S. 48 miles, West 32 miles, and S. S. W. ½ W. 18 miles: required her course and distance made good, and her present latitude.

Answer. Course S. 24° 45′ W., or S. S. W. ¼ W., distance 112 miles, and latitude in 36° 4′ S.

4. A ship from latitude 1° 12′ S., sails E. by N. ½ N. 56 miles, N. ½ E. 80 miles, S. by E. ½ E. 96 miles, N. ½ E. 68 miles, E. S. E. 40 miles, N. N. W. ½ W. 86 miles, and E. by S. 65 miles: required her direct course, distance, and her present latitude.

Answer. Course N. 51° 47′ E., or N. E. ½ E. nearly, distance 193. 8 miles, and present latitude 0° 48′ N.

5. A ship from latitude 46° 18′ N., sails N. 25° W. 50 miles, N. 74° E. 64 miles, S. 52° W. 36 miles, N. 35° E. 40 miles, N. 69° W. 75 miles, and S. 47° E. 48 miles: required her course, distance, and latitude in.

Answer. Course North, distance 67. 7 miles, and latitude in 47° 26′ N.

6. A ship from latitude 51° 30′ N., running at the rate of 8 knots an hour, sails W. S. W. 3 hours, N. W. 2½ hours, West 4 hours, S. W. by S. 2½ hours, and N. W. ½ W. 2 hours: required her course, distance, and latitude in.

Answer. Course West, distance 90. 7 miles, and latitude in 51° 30′ N.

7. A ship from a Port in latitude 38° 42′ N., bound to another Port situated in latitude 36° 32′ N., and 137 miles to the eastward, sails the following courses: S. by W. ½ W. 55 miles, S. W. b. S. ½ W. 37 miles, South 60 miles, E. S. E. 40 miles, S. E. b. S. ¼ E. 32 miles, and N. E. b. E. ½ E. 58 miles: required her direct course and distance made good, her present latitude, and the direct course and distance to her intended Port.

Answer. The course made good is S. 23° 38′ E., and the distance 169 miles; the latitude in 36° 7′ N., the course to the intended Port N. 70° 8′ E., and the distance 73. 56 miles.

8. The course (by compass) from Beachy Head to Selsea Bill is N. 67° W. and distance 40 miles; from Selsea Bill to St. Catherine's Point N. 86° W. 21 miles; from St. Catherine's Point to Portland Lights N. 69° W. 44 miles; from Portland Lights to the Start N. 85° W. 49 miles: required the course and distance from Beachy Head to the Start.

Answer. The course is N. 75° 51′ W. or W. N. W. ¾ W., and distance 152. 2 miles.

9. Suppose a ship to sail upon the following courses and distances:— S. E. by S. 29 miles, N. N. E. 10, E. S. E. 50, E. N. E. 50, S. S. E. 10, N. E. by N. 29, West 25, S. S. E. 10, W. S. W. ½ W. 42, North 110, E. ¾ N. 62, North 7, West 62, North 10, West 8, South 10, West 62, South 7, E. ¾ S. 62, South 110, W. N. W. ½ W. 42, N. N. E. 10, and West 25 miles: required her course and distance made good.

Answer. The ship has returned to the place she sailed from.

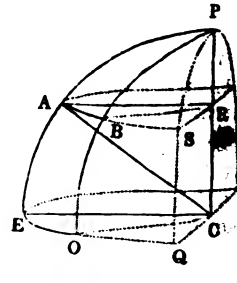
NOTE. This example is taken from "Robertson's Elements of Navigation;" the figure forming the shape of an Anchor.

# PARALLEL SAILING.

In Plane Sailing it was observed that the meridians are considered as being all parallel to each other, and the length of a degree on the meridian and parallel every where equal; which supposition will give just conclusions, so far as the course, distance, difference of latitude, and departure, are concerned; because a ship, when sailing on a rhumb, makes equal angles with the meridians: but as the earth is a sphere, or globe, and the meridians meet at the Poles, it is evident that the distance between any two meridians must vary in every latitude, their greatest distance being at the Equator, on which the difference of longitude is measured: hence the difference of longitude always exceeds the departure, or meridian distance (except on the Equator, where they are the same), in proportion as the given places are situated further from the Equator.

PARALLEL SAILING is the method of finding the distance between two places in the same latitude when their difference of longitude is known, or of finding the difference of longitude answering to the meridian distance or departure made good, when a ship sails due east or west.

This sailing is particularly useful in making small or low islands, in which case it is usual to run into the latitude, and then steer due east or west.




The principles upon which Parallel Sailing depends, may be thus illustrated: Let PAEC represent a section of one-fourth part of the earth, through the centre C, and one of the Poles P; then PAE will be part of a meridian, PC the polar, and EC the equatorial, semi-axis; also let PBO represent part of another meridian, A and B two places in the same parallel, being equally distant from the Equator EOQ; then will AB be the meridian distance, and EO their difference of longitude; the arches AE or BO will measure their latitude, and AP or BP their co. latitude; AR, the radius of the parallel ABS, will be the sine of the arch AP, the co. latitude; or co. sine of AE the latitude of A or B. Now the angles ARB and ECO being equal, the arches AB and EO are similar; and as circles and similar arches of circles are in direct ratio to their radii, therefore

EC (or AC) : EO :: AR : AB.

That is, As radius,
Is to difference of longitude,
So is co. sine of latitude,
To the meridian distance.

Or, As radius,
Is to any given portion of the Equator,
So is co. sine of latitude,
To a similar portion of a given parallel.

And, A R : A B :: E C (or A C) : E O.

That is, As co. sine of latitude
Is to meridian distance,
So is radius
To difference of longitude.

Also, E O : E C :: A B : A R.

That is, As difference of longitude
Is to radius,
So is meridian distance
To co. sine of latitude.

Hence, if a triangle, as A B C (see figure in Case I.), be so constructed that the longest side A C may represent the difference of longitude in miles, the base A B the meridian distance, and the angle opposite to it A C B the co. latitude, consequently the other angle B A C equal to the latitude, and any two of these parts be given, the other may be found by Trigonometry.

## CASE I.

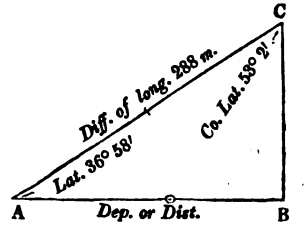
*The Difference of Longitude between two Places, both in one Parallel of Latitude given, to find their Distance.*

EXAMPLE. A ship in latitude 36° 58′ N., and longitude 20° 25′ W., is bound to St. Mary's, one of the Western Islands, in the same latitude, and in longitude 25° 13′ W., what distance must she run to arrive at the Island?

| | | | | |
|---|---|---|---|---|
| | 90° 0′ | Longitude of ship ..... | 20° 25 | W. |
| Latitude..... | 36 58 | Longitude of St. Mary.. | 25 13 | W. |
| Co. latitude... | 53 2 | Diff. of longitude ..... | 4 48 | =288 miles. |

### BY CONSTRUCTION.

Draw the line A B of any length, and make the angle C A B equal to the latitude 36° 58′ (Prob. XII. Geom.); from A to C lay off the difference of longitude 288, and from C draw C B perpendicular to A B (Prob. III. Geom.); then will A B measure 230, the departure or distance required.




### BY CALCULATION.

*To find the Departure or Distance.*

| | |
|---|---|
| As radius ..... | 10. 00000 |
| Is to the difference of longitude A C 288... | 2. 45939 |
| So is the co. sine of latitude 36° 58′ ..... | 9. 90254 |
| | 12. 36193 |
| | 10. 00000 |
| To the departure or distance A B 230. 1... | 2. 36193 |

### BY INSPECTION.

Seek for the complement of the latitude 53° among the degrees in the Traverse Table, as if it were a course, and for the difference of longitude 288 in one of the distance columns of that page, opposite to which, in the departure column, will be found 230, the departure or distance required.

### BY GUNTER'S SCALE.

Extend from 90° to the co. latitude 53° 2′ on the line of sines; that extent will reach from the difference of longitude 288 to the distance 230. 1 on the line of numbers.

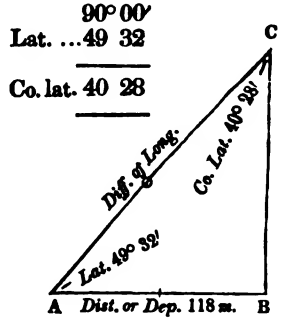
## CASE II.

*The Distance between two Places both in the same Parallel of Latitude given, to find the Difference of Longitude.*

EXAMPLE. A ship from latitude 49° 32′ N., and longitude 10° 16′ W., sails due West 118 miles: required her present longitude.

### BY CONSTRUCTION.

Draw the line A B, which make equal to the given distance 118, and make the angle C A B equal to the latitude 49° 32′ (Prob. XII. Geom.); upon B erect the perpendicular B C, cutting the line A C in C (Prob. II. Geom.); then will the line A C measure 182, the difference of longitude required.




### BY CALCULATION.

*To find the Diff. of Longitude.*

| | |
|---|---|
| As co. sine of lat. 49° 32′ | 9. 81225 |
| Is to the distance A B 118 | 2. 07188 |
| So is radius | 10. 00000 |
| | 12. 07188 |
| | 9. 81225 |
| To the diff. of long. 181. 8 | 2. 25963 |

*To find the Longitude in.*

| | | |
|---|---|---|
| Longitude left | 10° 16′ | W. |
| Diff. of longitude 182m. or | 3 2 | W. |
| Longitude in | 13 18 | W. |

### BY INSPECTION.

Look for the co. latitude 40° in the Table, as a course, and for the distance 118 in one of the departure columns, opposite to which, in the distance column, will be found 184; but as the co. latitude is nearly half

way between 40° and 41°, look again in the page with 41° at the top, for the distance 118 in one of the departure columns, and opposite, in the distance column, will be found 180; then half the sum of this and 184, found before, will be 182, the difference of longitude.

BY GUNTER'S SCALE.

Extend from the co. latitude 40° 28′ to radius 90° on the line of sines; that extent will reach from the distance 118 to the difference of longitude 182 miles.

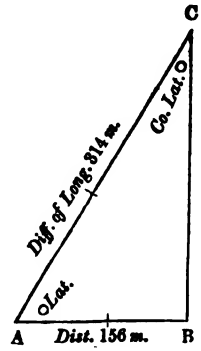
## CASE III.

*The Difference of Longitude and Distance between two Places in the same Parallel of Latitude given, to find the Latitude of that Parallel.*

EXAMPLE. A ship sails due East 156 miles, and then finds she has altered her longitude 314 miles: required the latitude of the parallel she has sailed on.

BY CONSTRUCTION.

Draw the line A B, and make it equal to the distance 156; on B erect the perpendicular B C, and with an extent in the compasses equal to the difference of longitude 314, set one foot in A, and with the other describe an arch cutting B C in C, and draw the line A C; then the angle C A B will measure 60° 13′ (Prob. XIII. Geom.), the latitude required.




BY CALCULATION.

*To find the Parallel of Latitude sailed on.*

| | |
|---|---|
| As the difference of longitude A C 314 ... | 2. 49693 |
| Is to radius ..... | 10. 00000 |
| So is the distance or departure A B 156 ... | 2. 19312 |
| | 12. 19312 |
| | 2. 49693 |
| To co. sine of the latitude 60° 13′ ..... | 9. 69619 |

BY INSPECTION.

Seek in the several pages of the Table till half the difference of longitude and distance, *viz.* 157 and 78, (the whole exceeding the limits of the Table) are found opposite each other in the distance and departure columns, which will give the co. latitude 30° at the top of the page, and consequently the latitude required will be 60°.

### BY GUNTER'S SCALE.

Extend from the difference of longitude 314 to the distance 156 on the line of numbers; that extent will reach from 90° to the complement of the latitude 29° 47′ on the line of sines: hence the latitude required is 60° 13′.

### EXAMPLES FOR EXERCISE.

1. A ship having taken her departure from North Cape, New Zealand, in latitude 34° 24′ S., and longitude 173° 10′ E., being bound to Port Jackson, sails due West until she arrives in longitude 163° 35′ E.: required her distance run.

Answer. Distance 474. 4 miles.

2. A ship from Buchanness, in latitude 57° 29′ N., and longitude 1° 47′ W., sails due East 125 miles: required her present longitude.

Answer. Longitude in 2° 6′ E.

3. A ship in latitude 32° 22′ N., and longitude 52° 20′ W., sails West 365 miles: required her distance from the Island of Bermuda, in the same latitude, and in longitude 64° 43′ W.

Answer. Distance of ship from Bermuda 262. 6 miles.

4. A ship in latitude 60° N., and longitude 22° 30′ W., sails West 200 miles: required her present longitude.

Answer. Longitude in 29° 10′ W.

5. If a ship take her departure from Cape St. Antonio (at the entrance to the River Plate), which lies in latitude 36° 19′ S., and longitude 56° 42′ W., how far must she sail due East to arrive at the meridian of the Cape of Good Hope, in longitude 18° 24′ E.?

Answer. 3631 miles.

6. In what parallel of latitude is the departure or meridian distance one third the difference of longitude?

Answer. In latitude 70° 32′.

7. A ship from longitude 81° 36′ W., sails West 310 miles, and then finds by observation she is in longitude 91° 50′ W.; on what parallel of latitude has she sailed?

Answer. In latitude 59° 41′.

8. Suppose a ship from latitude 35° 30′ N., and longitude 6° 15′ W., sails West 250 miles, North 525 miles, and then East 250 miles: required her present latitude and longitude.

Answer. Latitude 44° 15′ N., and longitude 5° 33′ W.

9. A ship from latitude 49° 32′ N., and longitude 21° 56′ W., sails N. W. by N. 20 miles, S. W. 40 miles, N. E. by E. 60 miles, S. E. 55 miles, W. by S. 41 miles, and E. N. E. 66 miles: required her present latitude and longitude.

Answer. Latitude 49° 32′ N., and longitude 20° 8′ W.

# MIDDLE LATITUDE SAILING.

WHEN a ship sails due North or South, she keeps on the same meridian, and therefore does not change her longitude, and her distance run is the difference of latitude: consequently her place is easily determined by the latitude left, and difference of latitude. Again, when a ship sails due East or West, her difference of longitude is found by the latitude in, and departure or meridian distance, as already explained in Parallel Sailing; but when she sails upon any other course, she changes both her latitude and longitude. Now the difference of longitude cannot be inferred either from the departure, considered as a meridian distance in the latitude left, or that come to; for in the greater latitude it would give the difference of longitude too much, and in the lesser latitude too little: the departure is therefore accounted a meridian distance in the mean of the two latitudes, and then the difference of longitude is found as in Parallel Sailing; hence this method, which is compounded of Plane and Parallel Sailing, is called MIDDLE LATITUDE SAILING.

The middle latitude is half the sum of the two latitudes when they are of the same name; or half their difference, if of contrary names.*

This method of sailing, although not strictly accurate, especially in high latitudes, approaches sufficiently near the truth for a day's run; but it is used principally in low latitudes, and when the ship makes a course nearly east or west.

## CASE I.

### *The Latitudes and Longitudes of two Places given, to find the Course and Distance between them.*

EXAMPLE. Required the course and distance from Cape St. Vincent, in latitude 37° 3′ N., and longitude 9° 1′ W., to Funchal, in Madeira, in latitude 32° 38′ N., and longitude 16° 56′ W.

---

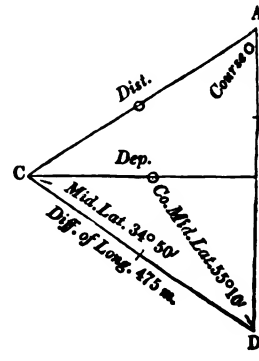
* The middle latitude computed as above, not being exactly the parallel in which the meridian distance is equal to the departure, the correct parallel, or as it may be called, the true middle latitude, may be found by the following proportion, *viz.*, Mer. diff. latitude : (proper) diff. latitude :: radius : co. sine (true) middle latitude; which proportion may be thus investigated:—

First, By Middle Latitude Sailing, diff. lat. : diff. long. :: co. sine middle lat. : tangent course; therefore, $\frac{\text{diff. long.} \times \text{co. si. mid. lat.}}{\text{diff. lat.}}$ = tangent course; and by Mercator's Sailing, Mer. diff. lat. : diff. long. :: radius : tangent course, or $\frac{\text{diff. long.} \times \text{radius}}{\text{Mer. diff. lat.}}$ = tangent course. Hence $\frac{\textit{diff. long.} \times \text{co. si. mid. lat.}}{\text{diff. lat.}} = \frac{\textit{diff. long.} \times \text{radius}}{\text{Mer. diff. lat.}}$ consequently Mer. diff. lat. × co. si. mid. lat. = radius × diff. lat., and therefore Mer. diff. lat. : radius : (proper) diff. lat. :: co. si. (true) middle latitude; or Mer. diff. lat. : (proper) diff. lat. : radius : co. sine (true) middle latitude.

| | | | | | |
|---|---|---|---|---|---|
| Lat. Cape St. Vincent | 37° 3′ N. | — | 37° 3′ | Long. C. St. Vinc. | 9° 1′ W. |
| Lat. Funchal ..... .. | 32 38 N. | — | 32 38 | Long. Funchal | 16 56 W. |
| Diff. of latitude | 4 25 | Sum 2) | 69 41 | Diff. of long. | 7 55 |
| | 60 | | | | 60 |
| | | Mid. lat. | 34 50 | | |
| In miles | 265 | | 90 0 | In miles | 475 |
| | | Co. mid. lat. | 55 10 | | |

BY CONSTRUCTION.

Draw the line A D to represent the meridian of Cape St. Vincent; make the angle A D C equal to the co. mid. lat. 55° 10′, (Prob. XII. Geom.), and from D to C lay off the difference of longitude 475; from C draw the line B C perpendicular to A D, (Prob. III. Geom.); make B A equal to the difference of latitude 265, and draw the line A C: then will B C represent the departure 389. 9, the angle B A C the course 55° 48′, or 5 points nearly; and A C the distance 471. 5 miles.




BY CALCULATION.

*To find the Departure.*

| | |
|---|---|
| As radius | 10. 00000 |
| Is to diff. of long 475 | 2. 67669 |
| So is co. sine mid. lat. 34° 50′ | 9. 91425 |
| | 12. 59094 |
| | 10. 00000 |
| To the departure 389. 9 | 2. 59094 |

*To find the Course.*

| | |
|---|---|
| As diff. of latitude 265 | 2. 42325 |
| Is to radius | 10. 00000 |
| So is departure 389. 9 | 2. 59095 |
| | 12. 59095 |
| | 2. 42325 |
| To tang. course 55° 48′ | 10. 16770 |

*To find the Course without Dep.**

| | |
|---|---|
| As diff. of lat. 265 | 2. 42325 |
| Is to diff. of long. 475 | 2. 67669 |
| So is co. sine mid. lat. 34° 50′ | 9. 91425 |
| | 12. 59094 |
| | 2. 42325 |
| To tang. course 55° 48′ | 10. 16769 |

*To find the Distance.*

| | |
|---|---|
| As radius | 10. 00000 |
| Is to the diff. of latitude 265 | 2. 42325 |
| So is sec. course 55° 48′ | 10. 25020 |
| | 12. 67345 |
| | 10. 00000 |
| To distance 471. 5 | 2. 67345 |

* This proportion is deduced from the two preceding, as may be thus demonstrated: first, rad. : diff. long. :: co. s. mid. lat. : depr.; therefore rad. × dep. = co. s. mid. lat. × diff. long.; also, diff. lat. : rad. :: depr. : tang. course; therefore rad. × dep., = diff. lat. × tang. course; consequently diff. lat. × tang. course = co. s. mid. lat. × diff. long.; whence diff. lat. : co. s. mid. lat. :: diff. long. : tang. course; or, diff. lat. : diff. long. :: co. s. mid. lat. : tang. course.

Hence the course from Cape St. Vincent to Funchal is S. 55° 48′ W., or S. W. b. W. nearly, and the distance 471. 5 miles.*

BY INSPECTION.

Look for the co. middle latitude 55°, as if it were a course, and for 237, half the difference of longitude (the whole being too great) in a distance column, immediately opposite to which, in the departure column, will be found 194. 1; this multiplied by 2, gives the departure 388. 2.

Then 132. 5, half the difference of latitude, and 194. 1, half the departure, being found nearly opposite each other in their respective columns, will give the course 56°, or 5 points, and half the distance 235, which multiplied by 2, gives the distance 470 miles.

BY GUNTER'S SCALE.

Extend from 90° to the complement of middle latitude 55° 10′ on the line of sines; that extent will reach from the difference of longitude 475 to the departure 389. 9 on the line of numbers.

Extend from the difference of latitude 265 to the departure 389. 9 on the line of numbers; that extent will reach from 45° to the course 55° 48′ on the line of tangents.

Extend from the complement of the course 34° 12′ to 90° on the line of sines; that extent will reach from the difference of latitude 265 to the distance 471. 5 on the line of numbers.

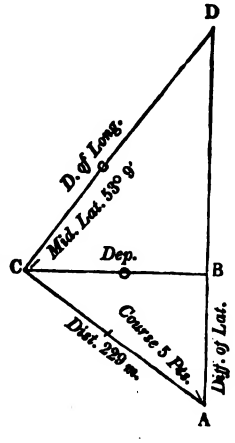
## CASE II.

### *One Latitude, Course, and Distance given, to find the Difference of Latitude and Longitude.*

EXAMPLE. A ship from lat. 52° 6′ N., and long. 35° 6′ W., sails N.W.b.W. 229 miles: required her present latitude and longitude.

BY CONSTRUCTION.

Draw the line A D, and make the angle D A C equal to the course 5 points; lay off, from A to C, the distance 229, and draw the line C B perpendicular to the line A D; then will the departure C B measure 190. 4, and the diff. of latitude A B 127: hence the latitude in is 54° 13′, and the middle latitude 53° 9′. Now make the angle B C D equal to the middle latitude 53° 9′, then will C D be the difference of longitude, measuring 317. 4 miles.




* If the true middle latitude were found by the proportion given at the bottom of page 85 (34° 52′), the course would be 55° 47′, and the distance 471. 3; the same exactly as found by Mercator's Sailing.

## BY CALCULATION.

*To find the Difference of Latitude.*

| | |
|---|---|
| As radius | 10. 00000 |
| Is to distance 229 | 2. 35984 |
| So is co. sine course 5 pts. | 9. 74474 |
| | 12. 10458 |
| | 10. 00000 |
| To the diff. of lat. 127. 2 | 2. 10458 |

| | | |
|---|---|---|
| Diff. of lat. 127 miles, or | | 2° 7′ N. |
| Latitude left | | 52 6 N. |
| Latitude in | | 54 13 N. |
| Sum of latitudes | 2) 106 19 | |
| Middle latitude | | 53 9 |
| | | 90 0 |
| Co. mid. latitude | | 36 51 |

*To find the Departure.*

| | |
|---|---|
| As radius | 10. 00000 |
| Is to distance 229 | 2. 35984 |
| So is sine course 5 pts. | 9. 91985 |
| | 12. 27969 |
| | 10. 00000 |
| To the departure 190. 4 | 2. 27969 |

*To find the Difference of Longitude.*

| | |
|---|---|
| As co. sine mid. lat. 53° 9′ | 9. 77795 |
| Is to departure 190. 4 | 2. 27967 |
| So is radius | 10. 00000 |
| | 12. 27967 |
| | 9. 77795 |
| To the diff. of long. 317. 5 | 2 50172 |

*To find Diff. Longitude without Dep.**

| | |
|---|---|
| As co. sine mid. lat. 53° 9′ | 9. 77795 |
| Is to diff. of lat. 127. 2 | 2. 10449 |
| So is tang. course 5 pts. | 10. 17511 |
| | 12. 27960 |
| | 9. 77795 |
| To the diff. of long. 317. 4 | 2. 50165 |

*To find the Longitude in.*

| | |
|---|---|
| Longitude left | 35° 6′ W. |
| Diff. of long. 317m. or | 5 17 W. |
| Longitude in | 40 23 W. |

## BY INSPECTION.

Look for the course 5 points at the bottom of the pages, over which, and opposite the distance 229 in its column, will be the diff. of latitude 127. 2, and departure 190. 4, in their respective columns.

Look for the co. mid. latitude 37° (being the nearest to 36° 51′) as if it were a course, and for half the departure 95. 2 in its column, opposite the nearest to which, in the distance column, will be found 158; this, multiplied by 2, gives the difference of longitude, 316 miles.

* Or, by considering the whole figure A C D as an oblique-angled triangle, it may be stated thus: as co. sine mid. lat. is to distance, so is sine course to diff. of longitude.

### BY GUNTER'S SCALE.

Extend from 8 points to the complement of the course 3 points on the line of sine rhumbs; that extent will reach from the distance 229 to the difference of latitude 127. 2.

Extend from 8 points to the course 5 points on the line of sine rhumbs; that extent will reach from the distance 229 to the departure 190. 4

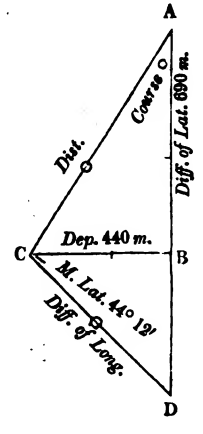
Extend from the co. mid. latitude 36° 51′ to 90° on the line of sines; that extent will reach from the departure 190. 4 to the difference of longitude 317. 4.

## CASE III.

*Both Latitudes and Departure given, to find the Course, Distance, and Difference of Longitude.*

EXAMPLE. A ship from latitude 49° 57′ N. and longitude 5° 11′ W. sails between the South and West until she arrives in latitude 38° 27′ N., and finds she has made 440 miles of departure: required the course she has steered, the distance run, and the longitude she is in.

| | | | |
|---|---|---|---|
| Latitude left | 49° 57′ N. | | 49° 57′ N. |
| Latitude in | 38 27 N. | | 38 27 N. |
| Diff. of latitude | 11 30 | Sum 2) | 88 24 |
| | 60 | Mid. lat. | 44 12 |
| In miles | 690 | | 90 00 |
| | | Co. mid. lat. | 45 48 |




### BY CONSTRUCTION.

Draw the line A D, and from A to B lay off the difference of latitude 690; on B erect the perpendicular B C, which make equal to the departure 440, and join A C: draw the line C D, so as to make an angle with C B, equal to the middle latitude 44° 12′; then the course C A B will measure 32° 31′, the distance A C 818. 5, and the difference of longitude D C 613. 7.

### BY CALCULATION.

| *To find the Course.* | | *To find the Distance.* | |
|---|---|---|---|
| As diff. of latitude 690 | 2. 83885 | As sine of course 32° 31′ | 9. 73042 |
| Is to radius | 10. 00000 | Is to departure 440 | 2. 64345 |
| So is departure 440 | 2. 64345 | So is radius | 10. 00000 |
| | 12. 64345 | | 12. 64345 |
| | 2. 83885 | | 9. 73042 |
| To tang. course 32° 31′ | 9. 80460 | To the distance 818. 5 | 2. 91303 |

| *To find the Difference of Longitude.* | |
|---|---|
| As co. sine mid. lat. 44° 12′ | 9.85547 |
| Is to departure 440 | 2.64345 |
| So is radius | 10.00000 |
| | 12.64345 |
| | 9.85547 |
| To diff. of long. 613.7 | 2.78798 |

| *To find the Longitude in.* | |
|---|---|
| Longitude left | 5° 11′ W. |
| Diff. of long. 614m. or | 10 14 W. |
| Longitude in | 15 25 W. |

BY INSPECTION.

One fourth the difference of latitude and departure, that is, 172. 5 and 110, are found to correspond nearly under 32° and 33°, the departure opposite the difference of latitude 172. 5, being too little under 32°, and too much under 33°; therefore the course is about 32½ degrees, and the distances answering to these are 203 and 206: their sum 409, divided by 2, gives one fourth the distance 204. 5, which, multiplied by 4, gives the whole distance 818.

The complement of middle latitude 46° taken as a course, with one-fourth the departure 110, in its column, gives in the distance column 153; this, multiplied by 4, will be the difference of longitude 612.

BY GUNTER'S SCALE.

Extend from the difference of latitude 690, to the departure 440 on the line of numbers; that extent will reach from 45° to the course 32° 31′ on the line of tangents.

Extend from the course 32° 31′ to 90° on the line of sines; that extent will reach from the departure 440 to the distance 818. 5 on the line of numbers.

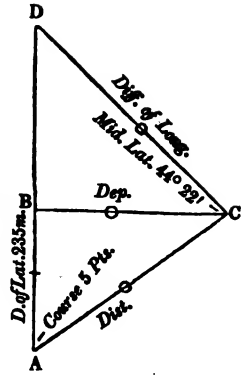
Extend from the co. mid. lat. 45° 48′ to 90° on the line of sines; that extent will reach from the departure 440 to the difference of longitude 613. 7 on the line of numbers.

## CASE IV.

*Both Latitudes and Course given, to find the Departure, Distance, and Difference of Longitude.*

EXAMPLE. A ship from latitude 42° 25′ N., and longitude 15° 6′ W., sails N. E. b. E. for several days, and then finds by observation that she is in latitude 46° 20′ N.: required the distance she has sailed, and her present longitude.

| | | | |
|---|---|---|---|
| Latitude left | 42° 25′ N. | ..... | 42° 25′ N. |
| Latitude by obs. | 46 20 N. | ..... | 46 20 N. |
| Diff. of latitude | 3 55 | Sum 2) | 88 45 |
| | 60 | | |
| | | Mid. lat. | 44 22 |
| In miles | 235 | | 90 00 |
| | | Co. mid. lat. | 45 38 |




BY CONSTRUCTION.

Draw the line A D, and from A to B lay off the difference of latitude 235; on B erect the perpendicular B C, and make the angle B A C equal to the course 5 points; draw the line C D, making an angle equal to the middle latitude 44° 22′ with B C; then the departure B C will measure 352, the distance A C 423, and the difference of longitude D C 492.

BY CALCULATION

*To find the Departure.*

| | |
|---|---|
| As radius | 10. 00000 |
| Is to diff. of latitude 235 | 2. 37107 |
| So is tang. course 5 pts. | 10. 17511 |
| | 12. 54618 |
| | 10. 00000 |
| To the departure 351. 7 | 2. 54618 |

*To find the Distance.*

| | |
|---|---|
| As co. sine of course 5 pts. | 9. 74474 |
| Is to diff. of latitude 235 | 2. 37107 |
| So is radius | 10. 00000 |
| | 12. 37107 |
| | 9. 74474 |
| To the distance 423 | 2. 62633 |

*To find the Difference of Longitude.*

| | |
|---|---|
| As co. sine mid. lat. 44° 22′ | 9. 85423 |
| Is to departure 351. 7 | 2. 54617 |
| So is radius | 10. 00000 |
| | 12. 54617 |
| | 9. 85423 |
| To diff. of longitude 492 | 2. 69194 |

*To find the Longitude in.*

| | |
|---|---|
| Longitude left | 15° 6′ W. |
| Diff. of long. 492m. or | 8 12 E. |
| Longitude in | 6 54 W. |

BY INSPECTION.

Over the course 5 points, and opposite half the difference of latitude 117. 5, in its column, will be found half the departure 175. 4, and half the distance 211; these, multiplied by 2, give the whole departure 350. 8, and the distance 422.

The co. mid. lat. 45° 38′ being taken as a course between 45° and 46°, give opposite half the departure 175. 4, in the distance columns, 248 and 244; half the sum of these, *viz.* 246, will be half the difference of longitude, which, multiplied by 2, gives the difference of longitude 492.

BY GUNTER'S SCALE.

Extend from the complement of the course 3 points to the course 5 points on the line of sine rhumbs; that extent will reach from the difference of latitude 235 to the departure 351. 7 on the line of numbers.

Extend from the complement of the course 3 points to 8 points on the line of sine rhumbs; that extent will reach from the difference of latitude 235 to the distance 423 on the line of numbers.

Extend from the co. mid. lat. 45° 38′ to 90° on the line of sines; that extent will reach from the departure 351. 7 to the difference of longitude 492 on the line of numbers.

## CASE V.

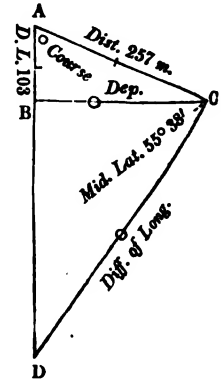
### *Both Latitudes and Distance given, to find the Course and Difference of Longitude.*

EXAMPLE. Suppose a ship from latitude 56° 30′ N. has sailed South-easterly 257 miles when she arrives in latitude 54° 47′ N.; required her course, and difference of longitude.

| | | | |
|---|---|---|---|
| Latitude left | 56° 30′ N. | | 56° 30′ N. |
| Latitude in | 54 47 N. | | 54 47 N. |
| Diff. of lat. | 1 43 | 2) | 111 17 |
| | 60 | | |
| | | Mid. lat. | 55 38 |
| In miles | 103 | | 90 00 |
| | | Co. mid. lat. | 34 22 |

BY CONSTRUCTION.

Draw the line A D, and from A to B lay off the difference of latitude 103; on B erect the perpendicular B C; and with the distance 257 in the compasses, placing one foot in A, let the other cross B C in C, and draw the line A C; draw C D, making with C B an angle equal to the middle latitude 55° 38′; then the course B A C will measure 66° 22′, and the difference of longitude C D 417.



BY CALCULATION.

*To find the Course.*

| | |
|---|---|
| As the distance 257 | 2.40993 |
| Is to radius | 10.00000 |
| So is diff. of lat. 103 | 2.01284 |
| | 12.01284 |
| | 2.40993 |
| To co. sine course 60° 22′ | 9.60291 |

*To find the Difference of Longitude.*

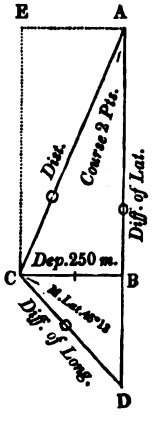
| | |
|---|---|
| As co. sine mid. lat. 55° 38′ | 9.75165 |
| Is to tang. course 60° 22′ | 10.35894 |
| So is diff. lat. 103 | 2.01284 |
| | 12.37178 |
| | 9.75165 |
| To diff. of longitude 417 | 2.62013 |

NOTE. We shall omit working this and the following Cases by Inspection and Gunter's Scale, as it is presumed the learner sufficiently understands those methods, without further instruction.

## CASE VI.

*One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.*

EXAMPLE. A ship sails S. S. W. from latitude 51° 15′ N., and longitude 9° 50′ W., until her departure is 250 miles: required the distance sailed, and her present latitude and longitude.




BY CONSTRUCTION.

Having drawn the line A D, make A E perpendicular to it, and equal to the departure 250; through E draw E C parallel to A D, and draw A C, making an angle with A D, equal to the course 2 points; draw C B parallel to A E, and the line C D, making an angle with C B, equal to the middle latitude 46° 13′; then will the difference of latitude A B, measure 608. 6, the distance A C 653. 3, and the difference of longitude C D 361. 3.

*To find the Difference of Latitude.*

| | |
|---|---|
| As sine of course 2 pts. | 9.58284 |
| Is to departure 250 | 2.39794 |
| So is co. sine of course 2 pts. | 9.96562 |
| | 12.36356 |
| | 9.58284 |
| To the diff. of lat. 603. 6 | 2.78072 |

| | | |
|---|---|---|
| Latitude left | 51° 15′ | N. |
| Diff. of latitude 604m. or | 10 4 | S. |
| Latitude in | 41 11 | N. |
| Sum of latitudes | 2) 92 26 | |
| Middle latitude | 46 13 | |
| | 90 00 | |
| Co. mid. latitude | 43 47 | |

| *To find the Distance.* | | *To find the Difference of Longitude.* | |
|---|---|---|---|
| As sine of course 2 pts. | 9.58284 | As co. sine mid. lat. 46° 13′ | 9.84006 |
| Is to departure 250 | 2.39794 | Is to departure 250 | 2.39794 |
| So is radius | 10.00000 | So is radius | 10.00000 |
| | 12.39794 | | 12.39794 |
| | 9.58284 | | 9.84006 |
| To the distance 653.3 | 2.81510 | To the diff. of long. 361.3 | 2.55788 |

| | | |
|---|---|---|
| Longitude left | 9° 50′ | W. |
| Diff. of longitude 361 miles, or | 6 1 | W. |
| Longitude in | 15 51 | W. |

## CASE VII.

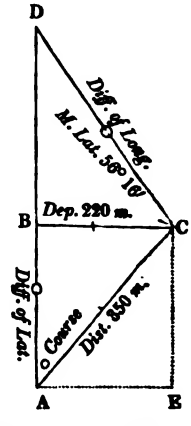
*One Latitude, Distance, and Departure given, to find the Course, Difference of Latitude, and Difference of Longitude.*

EXAMPLE. A ship from latitude 54° N., and longitude 33° 20′ W., sails 350 miles, between the North and East, until she has made 220 miles of departure: required the course steered, and her present latitude and longitude.

BY CONSTRUCTION.

Draw the line A D, and make A E perpendicular to it, and equal to the departure 220: through E draw E C parallel to A D, and, with the distance 350 in the compasses, set one foot in A, and let the other cross C E in C; join A C, and draw B C parallel to A E; then the course B A C will measure 38° 57′, and the difference of latitude A B 272.2: hence the latitude in will be 58° 32′, and the mid. lat. 56° 16′.

Make the angle B C D equal to 56° 16′, and the difference of longitude D C will measure 396.2.




BY CALCULATION.

| *To find the Course.* | | *To find the Difference of Latitude.* | |
|---|---|---|---|
| As the distance 350 | 2.54407 | As radius | 10.00000 |
| Is to radius | 10.00000 | Is to distance 350 | 2.54407 |
| So is departure 220 | 2.34242 | So is co. sine of course 38° 57′ | 9.89081 |
| | 12.34242 | | 12.43488 |
| | 2.54407 | | 10.00000 |
| To sine of course 38° 57′ | 9.79835 | To the diff. of lat. 272.2 | 2.43488 |

| | | |
|---|---|---|
| Latitude left | 54° 0′ | N. |
| Diff. of lat. 272m. or | 4 32 | N. |
| Latitude in | 58 32 | N. |
| Sum of latitudes 2) | 112 32 | |
| Mid. latitude | 56 16 | |
| | 90 00 | |
| Co. mid. latitude | 33 44 | |

*To find the Difference of Longitude.*

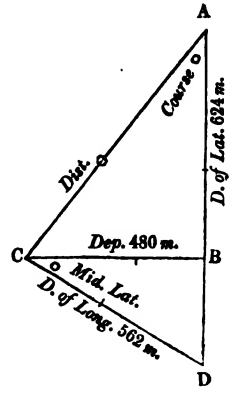
| | |
|---|---|
| As co. sine mid. lat. 56° 16′ | 9.74455 |
| Is to departure 220 | 2.34242 |
| So is radius | 10.00000 |
| | 12.34242 |
| | 9.74455 |
| To the diff. of long. 396.2 | 2.59787 |

| | | |
|---|---|---|
| Longitude left | 33° 20′ | W. |
| Difference of longitude 396 miles, or | 6 36 | E. |
| Longitude in | 26 44 | W. |

## CASE VIII.

*One Latitude, Departure, and Difference of Longitude given, to find the other Latitude, Course, and Distance.**

EXAMPLE. A ship from latitude 36° 32′ N. sails between the South and West until she has made 480 miles of departure, and 562 miles of difference of longitude: required her present latitude, course steered, and distance run.




### BY CONSTRUCTION.

Having drawn the line A D, make B C perpendicular to it, and equal to the departure 480; draw C D equal to the difference of longitude 562, meeting A D in D; then the middle latitude B C D will measure 31°20′; hence the latitude in is 26° 8′, and the difference of latitude 624: now make A B equal to 624, and join A C, which will measure the distance 787.2, and the course C A B will be 37° 34′.

### BY CALCULATION.

*To find the Middle Latitude.*

| | |
|---|---|
| As the diff. of long. 562 | 2.74974 |
| Is to radius | 10.00000 |
| So is departure 480 | 2.68124 |
| | 12.68124 |
| | 2.74974 |
| To co. sine mid. lat. 31°20′ | 9.93150 |

| | | |
|---|---|---|
| Middle latitude | 31° 20′ | |
| | 2 | |
| Double mid. lat. | 62 40 | |
| Latitude left | 36 32 | N. |
| Latitude in | 26 8 | N. |
| Diff. of lat. | 10 24 | = 624 m. |

* This Case cannot be solved by Mercator's Sailing.

| *To find the Course.* | | *To find the Distance.* | |
|---|---|---|---|
| As diff. of lat. 624 | 2.79518 | As radius | 10.00000 |
| Is to radius | 10.00000 | Is to diff. of lat. 624 | 2.79518 |
| So is departure 480 | 2.68124 | So is sec. course 37° 34′ | 10.10092 |
| | 12.68124 | | 12.89610 |
| | 2.79518 | | 10.00000 |
| To tang. course 37° 34′ | 9.88606 | To the distance 787.2 | 2.89610 |

# MERCATOR'S SAILING.

MERCATOR'S SAILING is the art of finding on a plane surface the motion of a ship upon any assigned course of the compass which shall be true in latitude, longitude, and distance sailed. This method is derived from the projection of Mercator's Chart, in which the degrees of longitude are every where equal, the degrees of latitude increase towards the poles, and the parallels, meridians, and rhumb-lines are all represented by strait lines.

Charts, in which the degrees of longitude and latitude are every where equal, are termed PLANE CHARTS. These, it must appear obvious from what has been said in Parallel and Middle Latitude Sailing, are constructed on erroneous principles; and it is also evident that their error must increase in proportion as the places are more remote from the Equator; but the great inconvenience of using curved lines on a plane surface, induced mariners, notwithstanding their incorrectness, to use the Plane Charts, till Mr. Gerrard Mercator, about the year 1556, published a chart, in which he continued the meridians all parallel to each other, thereby extending the degrees of longitude beyond their proper length; but, in order to compensate for this expansion of the degrees of longitude, he enlarged the meridional lines, that is, increased the distance between the parallels, so that the proportion between a degree of latitude and longitude might be every where preserved on the chart, at the same time that the meridians, parallels, and rhumbs would be all projected into strait lines: whence a chart thus constructed has obtained the name of MERCATOR'S CHART. It does not, however, appear that Mercator understood the true principles of this projection, as he did not enlarge the meridional degrees in their just proportion.

In the year 1599, Mr. Edward Wright, of Caius College, Cambridge, published the true principles of Mercator's Chart, in a work entitled "*The Correction of certain Errors in Navigation*;" where he shewed, by a Table of *Meridional Parts*, the length of the enlarged meridians in miles of the

equator to every minute of latitude, and which Table he constructed according to the following principles:—

It has been already demonstrated in Parallel Sailing, that the length of any portion of a parallel is to a similar portion of the equator as the co. sine of the latitude is to radius; but the meridians and equator being equal on the globe, therefore the length of any portion of a parallel is to a similar portion of a meridian, as co. sine of the latitude is to radius; or, which is the same thing, as radius is to the secant of the latitude. Now, if the meridians are made parallel to each other, the length of a degree or minute of longitude will remain the same in every latitude as at the equator, by which they will be enlarged beyond their proper length in the ratio of radius to secant of the latitude; therefore, the length of the meridional degrees or minutes must be likewise increased in the same proportion. Hence the length of the first minute, or mile of latitude, from the equator will be represented by the secant 1′, (the length of a mile on the equator being radius); the second mile by the secant of 2′; the third mile by the secant of 3′, &c.: consequently the length of the meridional line to any latitude will be equal to the sum of the secants of all the intermediate miles between the equator and the given latitude.

This method of constructing meridional parts is not strictly accurate, because the secants should be taken to every point of latitude; but as the tables of meridional parts are seldom carried to decimals, the error is of no consequence in any navigable latitude. However, more accurate and expeditious methods have been since invented for the same purpose.

To find the length of the expanded meridian between any two parallels of latitude, or, as it is called, the meridional difference of latitude, the same rules are to be observed as in finding the true or proper difference of latitude—that is, if the latitudes are of the same name, the difference of their corresponding meridional parts (taken from Table III.); but if the latitudes are of contrary names, the sum of those parts will be the meridional difference of latitude.

From the principles of Mercator's Chart it is proved, that if A B (see the figure in Case I.) represent the true or proper difference of latitude between two places, the angle B A C the course, A C the true distance, B C the departure, as in Plane Sailing; and if we produce A B to D till it be equal to the enlarged or meridional difference of latitude, and draw D E parallel to B C, then will D E represent the difference of longitude. Now the triangles A B C and A D E are similar, the angle A being common to both, and the sides B C and D E parallel; therefore, as A B : B C :: A D : D E—that is, as the proper difference of latitude is to the departure, so is the meridional difference of latitude to the difference of longitude. Hence, likewise, in the triangle A D E, making A D radius, we have—As radius : A D :: tang. angle A : E D; that is, as radius is to mer. diff. of latitude, so is tangent of the course to the difference of longitude; or, making A E radius—As co. sine angle A : A D :: sine angle A : E D; that is, as co. sine of the course is to mer. diff. of latitude, so is sine of the course to the diff. of longitude: which proportions, with others derived from these triangles, will resolve all the Cases in Mercator's Sailing.

In the following Cases, except the eighth, the same examples are introduced as in Middle Latitude Sailing, in order that a comparison may be made between the two methods.

## CASE I.

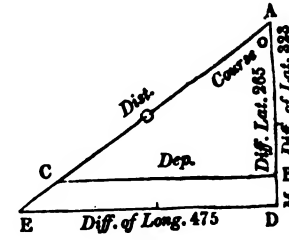
### *The Latitudes and Longitudes of Two Places given, to find the Course and Distance between them.*

EXAMPLE. Required the course and distance from Cape St. Vincent, in latitude 37° 3′ N. and longitude 9° 1′ W. to Funchal, in Madeira, in latitude 32° 38′ N. and longitude 16° 56′ W.

| | | | | | |
|---|---|---|---|---|---|
| Lat. Cape St. Vinc. | 37° 3′ N. | Mer. parts | 2396 | Long. C. St. Vin. | 9° 1′ W. |
| Lat. Funchal | 32 38′ N. | Mer. parts | 2073 | Long. Funchal | 16 56 W. |
| Diff. of latitude | 4 25 | Mer. diff. of lat. | 323 | Diff. of long. | 7 55 |
| | 60 | | | | 60 |
| In miles | 265 | | | In miles | 475 |

BY CONSTRUCTION.

Draw the line A D to represent the meridian of Cape St. Vincent, upon which lay off the meridional difference of latitude 323; on D erect the perpendicular D E (Prob. II. or XII. Geom.); make it equal to the difference of longitude 475, and draw the line A E; from A to B lay off the proper difference of latitude 265, and through B draw B C parallel to D E; then will the angle E A D be the course, measuring 55° 47′, or 5 points nearly, and A C the distance, 471 miles.




BY CALCULATION.

| *To find the Course.* | | *To find the Distance.* | |
|---|---|---|---|
| As mer. diff. of lat. 323 | 2.50920 | As radius | 10.00000 |
| Is to radius | 10.00000 | Is to prop. diff. lat. 265 | 2.42325 |
| So is diff. of long. 475 | 2.67669 | So is sec. course 55° 47′ | 10.25001 |
| | 12.67669 | | 12.67326 |
| | 2.50920 | | 10.00000 |
| To tang. course 55° 47′ | 10.16749 | To the distance 471.3 | 2.67326 |

Hence the direct course from Cape St. Vincent to Funchal is S. 55° 47′ W. or S. W. b. W. nearly, and the distance 471 miles.

### BY INSPECTION.

Seek in the Tables for half the merid. diff. of lat. 161. 5, and half the diff. of longitude 237. 5, till they are found against each other in the lat. and dep. columns: the nearest to these are 160. 5 and 237. 9 in that page marked 56° at the bottom, which is the course; over that course, and opposite half the proper diff. of latitude, 132. 5 in its column, is found, in the dist. column, 237, which multiplied by 2, gives the distance required, 474 miles.

### BY GUNTER'S SCALE.

Extend from the mer. diff. of lat. 323 to the diff. of long. 475 on the line of numbers; that extent will reach from 45° to the course 55° 47′ on the line of tangents.

Extend from the complement of the course 34° 13′ to 90° on the line of sines; that extent will reach from the proper diff. of lat. 265, to the distance 471 on the line of numbers.

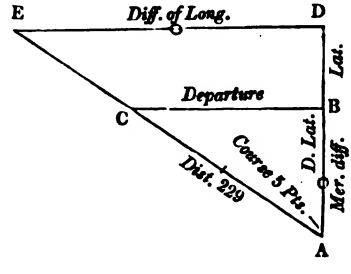
## CASE II.

*One Latitude, Course, and Distance given, to find the Difference of Latitude and Difference of Longitude.*

EXAMPLE. A ship from latitude 52° 6′ N. and longitude 35° 6′ W. sails N. W. b. W. 229 miles; required her present latitude and longitude.

### BY CONSTRUCTION.

Draw the line A D, and make the angle D A E equal to the course 5 points; from A to C lay off the distance 229, and from C draw C B perpendicular to A D; then will A B measure the diff. of latitude 127: hence the latitude come to is 54° 13′, and the mer. diff. of latitude 212; make A D equal to 212, and draw D E parallel to B C; then will the difference of longitude D E measure 317. 3.




### BY CALCULATION.

*To find the Difference of Latitude.*

| | |
|---|---|
| As radius | 10. 00000 |
| Is to distance 229 | 2. 35984 |
| So is co. sine course 5 pts. | 9. 74474 |
| | 12. 10458 |
| | 10. 00000 |
| To the diff. of lat. 127. 2 | 2. 10458 |

*To find the Latitude in.*

| | | | |
|---|---|---|---|
| Lat. left | 52° 6′ N. | Mer. pts. | 3675 |
| Diff. of lat. | 2 7 N. | | |
| Lat. in | 54 13 N. | Mer. pts. | 3887 |
| | | Mer. diff. of lat. | 212 |

| *To find the Difference of Longitude.* | |
|---|---|
| As radius | 10.00000 |
| Is to mer. diff. lat. 212 | 2.32634 |
| So is tang. course 5 pts. | 10.17511 |
| | 12.50145 |
| | 10.00000 |
| To diff. of longitude 317.3 | 2.50145 |

| *To find the Longitude in.* | |
|---|---|
| Longitude left | 35° 6′ W. |
| Diff. of long. 317m. or | 5 17 W. |
| Longitude in | 40 23 W. |

BY INSPECTION.

Over the course 5 points, and opposite the distance 229, is the difference of latitude 127. 2: hence the latitude come to is 54° 13′, and the mer. diff. of lat. 212; then over the course 5 points, and opposite half the mer. diff. of lat. 106, in a lat. column, will be found 158. 8 in a dep. column, which, multiplied by 2, gives the diff. of longitude 317. 6.

BY GUNTER'S SCALE.

Extend from 8 points to the complement of the course 3 points on the line of sine rhumbs; that extent will reach from the distance 229 to the difference of latitude 127. 2 on the line of numbers.

Extend from 4 points to the course 5 points on the line of tangent rhumbs; that extent will reach from the mer. diff. of latitude 212 to the diff. of longitude 317. 3.

## CASE III.

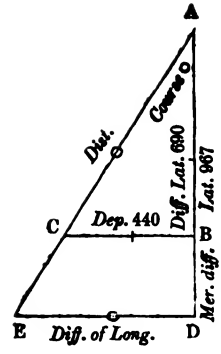
### *Both Latitudes and Departure given, to find the Course, Distance, and Difference of Longitude.*

EXAMPLE. A ship from latitude 49° 57′ N. and longitude 5° 11′ W. sails between the South and West until she arrives in latitude 38° 27′ N., and finds she has made 440 miles of departure: required the course she has steered, the distance run, and the longitude she is in.

| | | | |
|---|---|---|---|
| Latitude left | 49° 57′ N. | Mer. parts | 3470 |
| Latitude in | 38 27 N. | Mer. parts | 2503 |
| Diff. of latitude | 11 30 | Mer. diff. latitude | 967 |
| | 60 | | |
| Miles | 690 | | |

## BY CONSTRUCTION.

Having drawn the line A D, make A B equal to the proper diff. of latitude 690; on B erect the perpendicular B C, and make it equal to the departure 440; also make A D equal to the meridional diff. of latitude 967, and draw D E parallel to B C; through A and C draw the line A E, meeting D E in E; then will the angle C A B be the course 32° 31′, A C the distance 818. 5, and D E the difference of longitude 616. 5.




## BY CALCULATION.

*To find the Course.*

| | |
|---|---|
| As diff. of latitude 690 | 2. 83885 |
| Is to radius | 10. 00000 |
| So is departure 440 | 2. 64345 |
| | 12. 64345 |
| | 2. 83885 |
| To tang. course 32° 31′ | 9. 80460 |

*To find the Distance.*

| | |
|---|---|
| As sine of course 32° 31′ | 9. 73042 |
| Is to departure 440 | 2. 64345 |
| So is radius | 10. 00000 |
| | 12. 64345 |
| | 9. 73042 |
| To the distance 818. 5 | 2. 91303 |

*To find the Difference of Longitude.**

| | |
|---|---|
| As radius | 10. 00000 |
| Is to mer. diff. lat. 967 | 2. 98543 |
| So is tang. course 32° 31′ | 9. 80447 |
| | 12. 78990 |
| | 10. 00000 |
| To diff. of long. 616. 5 | 2. 78990 |

*To find the Longitude in*

| | | |
|---|---|---|
| Longitude left | 5° 11′ | W. |
| Diff. of long. 616m. or | 10 16 | W. |
| Longitude in | 15 27 | W. |

## BY INSPECTION.

One fourth the difference of latitude and departure, that is, 172. 5 and 110, are found to correspond nearly under 32° and 33°, the departure opposite the difference of latitude 172. 5, being too little under 32°, and too much under 33°: therefore the course is about 32½ degrees, and the distances answering to these are 203 and 206: their sum 409, divided by 2, gives one fourth the distance 204. 5, which, multiplied by 4, gives the whole distance 818.

* Or, since the triangles A B C and A D E are similar, the difference of longitude may be found independent of the course; for as A B : B C :: A D : D E; that is, as the proper diff. of lat. is to the dep., so is the mer. diff. of lat. to the diff. of longitude.

One fourth the mer. diff. of latitude 241. 7, in one of the lat. columns of the page marked with the course 32° at the top, gives in the dep. column 151. 0; and the same with the course 33° at the top, gives 156. 9; the sum of these is 307. 9, which, divided by 2, gives 153. 9; this multiplied by 4, gives the difference of longitude 615. 6.

### BY GUNTER'S SCALE.

Extend from the difference of latitude 690 to the departure 440 on the line of numbers; that extent will reach from 45° to the course 32° 31′ on the line of tangents.

Extend from the course 32° 31′ to 90° on the line of sines; that extent will reach from the departure 440 to the distance 818. 5 on the line of numbers.

Extend from 45° to the course 32° 31′ on the line of tangents; that extent will reach from the meridional diff. of latitude 967, to the difference of longitude 616. 5, on the line of numbers.

## CASE IV.

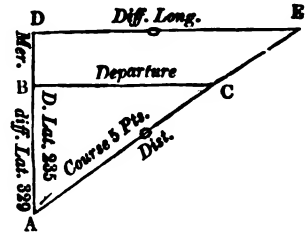
### *Both Latitudes and Course given, to find the Distance, and Difference of Longitude.*

EXAMPLE. A ship from latitude 42° 25′ N., and longitude 15° 6′ W., sails N. E. b. E. for several days, and then finds by Observation that she is in latitude 46° 20′ N.: required the distance she has sailed, and her present longitude.

| | | | |
|---|---|---|---|
| Latitude left | 42° 25′ N. | Mer. parts | 2815 |
| Latitude in by Obs. | 46 20 N. | Mer. parts | 3144 |
| Diff. of latitude | 3 55 | Mer. diff. latitude | 329 |
| | 60 | | |
| In miles | 235 | | |

### BY CONSTRUCTION.

Draw the line A D, and from A to B lay off the diff. of lat. 235; on B erect the perpendicular B C, and make the angle B A C equal to the course 5 points; lay off the mer. diff. of lat. 329 from A to D, and through D draw D E parallel to B C; then the distance A C will measure 423, and the diff. of longitude D E 492.



BY CALCULATION.

| *To find the Distance.* | | *To find the Difference of Longitude.* | |
|---|---|---|---|
| As co. sine of course 5 pts. | 9.74474 | As radius | 10.00000 |
| Is to diff. of latitude 235 | 2.37107 | Is to mer. diff. of lat. 329 | 2.51720 |
| So is radius | 10.00000 | So is tang. course 5 pts. | 10.17511 |
| | 12.37107 | | 12.69231 |
| | 9.74474 | | 10.00000 |
| To the distance 423 | 2.62633 | To diff. of long. 492.4 | 2.69231 |

Longitude left ..... 15° 6′ W.
Difference of longitude 492 miles, or ..... 8 12 E.

Longitude in ..... 6 54 W.

BY INSPECTION.

Over the course 5 points, and opposite half the difference of latitude 117.5 in its column, will be found half the distance 211 in its proper column; this, multiplied by 2, gives the whole distance 422.

Over the same course, and opposite half the mer. diff. of latitude 164.5, found in a latitude column, stands 246.1 in the corresponding dep. column; which, multiplied by 2, gives the diff. longitude 492.2.

BY GUNTER'S SCALE.

Extend from the complement of the course 3 points to 8 points on the line of sine rhumbs; that extent will reach from the difference of latitude 235 to the distance 423 on the line of numbers.

Extend from 4 points to the course 5 points on the line of tangent rhumbs; that extent will reach from the mer. diff. of lat. 329, to the diff. of longitude 492.4 on the line of numbers.

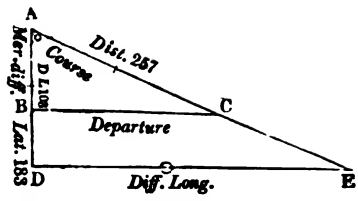
## CASE V.

### *Both Latitudes and Distance given, to find the Course and Difference of Longitude.*

EXAMPLE. Suppose a ship from latitude 56° 30′ N. has sailed Southeasterly 257 miles, when she arrives at latitude 54° 47′ N.: required her course steered, and difference of longitude.

| | | | |
|---|---|---|---|
| Latitude left | 56° 30′ N. | Mer. parts | 4128 |
| Latitude in | 54 47 N. | Mer. parts | 3945 |
| Diff. of latitude | 1 43 | Mer. diff. latitude | 183 |
| | 60 | | |
| Miles | 103 | | |

### BY CONSTRUCTION.




Draw the line A D, and from A to B lay off the diff. of latitude 103; on B erect the perpendicular B C, and with the distance 257 in the compasses set one foot in A, and with the other describe an arch cutting B C in C, and draw the line A C; from A to D lay off the mer. diff. of latitude 183, and through D draw D E parallel to B C, meeting A C produced in E; then the course B A C will measure 66° 22′, and the diff. of longitude D E 418. 2.

### BY CALCULATION.

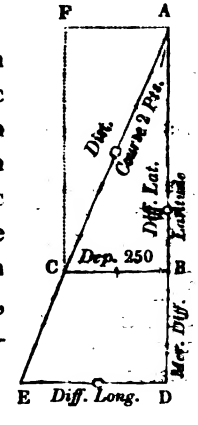
| *To find the Course.* | | *To find the Difference of Longitude.* | |
|---|---|---|---|
| As the distance 257 | 2. 40993 | As co. sine course 66° 22′ | 9. 60302 |
| Is to radius | 10. 00000 | Is to mer. diff. lat. 183 | 2. 26245 |
| So is diff. of lat. 103 | 2. 01284 | So is sine course 66° 22′ | 9. 96196 |
| | 12. 01284 | | 12. 22441 |
| | 2. 40993 | | 9. 60302 |
| To co. sine course 66° 22′ | 9. 60291 | To diff. of longitude 418. 2 | 2. 62139 |

## CASE VI.

*One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.*

EXAMPLE. A ship sails S. S. W. from latitude 51° 15′ N., and longitude 9° 50′ W. until her departure is 250 miles: required the distance sailed, and her present latitude and longitude.

### BY CONSTRUCTION.




Draw A D, and make A F perpendicular to it, on which lay off from A to F the dep. 250; through F draw F C parallel to A D, and draw A C, making an angle with A D equal to the course 2 points, meeting F C in C, through which draw C B parallel to F A; then will the distance A C measure 653, and the diff. of latitude A B 604: hence the latitude in is 41° 11′, and the mer diff. of lat. 877; from A to D lay off 877, and draw D E parallel to B C or F A, meeting A C produced in E; then will the diff. of longitude D E measure 363. 3.

### BY CALCULATION.

| *To find the Difference of Latitude.* | | *To find the Distance.* | |
|---|---|---|---|
| As sine of course 2 pts. | 9. 58284 | As sine of course 2 pts. | 9. 58284 |
| Is to departure 250 | 2. 39794 | Is to departure 250 | 2. 39794 |
| So is co. sine of course 2 pts. | 9. 96562 | So is radius | 10. 00000 |
| | 12. 36356 | | 12. 39794 |
| | 9. 58284 | | 9. 58284 |
| To the diff. of lat. 603. 6 | 2. 78072 | To the distance 653. 3 | 2. 81510 |

Lat. left 51° 15′ N. Mer. pts. 3593
Diff. lat. 10 4 S.

Lat. in 41 11 N. Mer. pts. 2716

Mer. diff. lat. 877

*To find the Difference of Longitude.*

| | |
|---|---|
| As co. sine of course 2 pts. | 9. 96562 |
| Is to mer. diff. lat. 877 | 2. 94300 |
| So is sine course 2 pts. | 9. 58284 |
| | 12. 52584 |
| | 9. 96562 |
| To the diff. of long. 363. 3 | 2. 56022 |

Longitude left 9° 50′ W.
Diff. of long. 363m. or 6 3 W.

Longitude in 15 53 W.

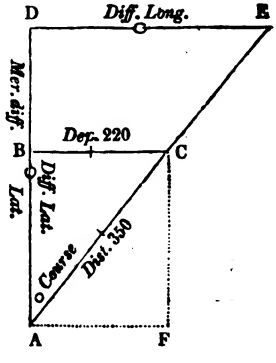
## CASE VII.

*One Latitude, Distance, and Departure given, to find the Course, Difference of Latitude, and Difference of Longitude.*

EXAMPLE. A ship from latitude 54° N., and longitude 33° 20′ W., sails 350 miles between the North and East until she has made 220 miles of departure: required the course steered, and her present latitude and longitude.

### BY CONSTRUCTION.

Draw A D and A F perpendicular to it, which make equal to the departure 220; through F draw F C parallel to A D, and with the distance 350 in the compasses, set one foot in A, and with the other draw an arch cutting F C in C; join A C, and draw B C parallel to A F; then the course B A C will measure 38° 57′, and the difference of lat. A B 272. 2: hence the latitude in is 58° 32′, and mer. diff. of latitude 490; from A to D lay off 490, and through D draw D E parallel to A F or B C, meeting A C produced in E; then the diff. of longitude D E will measure 396. 1.



BY CALCULATION.

*To find the Course.*

| | |
|---|---|
| As the distance 350 | 2.54407 |
| Is to radius | 10.00000 |
| So is departure 220 | 2.34242 |
| | 12.34242 |
| | 2.54407 |
| To sine of course 38° 57′ | 9.79835 |

*To find the Difference of Latitude.*

| | |
|---|---|
| As radius | 10.00000 |
| Is to distance 350 | 2.54407 |
| So is co. sine course 38° 57′ | 9.89081 |
| | 12.43488 |
| | 10.00000 |
| To the diff. of lat. 272.2 | 2.43488 |

Lat. left 54° 0′ N. Mer. pts. 3865
Diff. lat. 4 32 N.
Lat. in 58 32 N. Mer. pts. 4355
Mer. diff. lat. 490

Longitude left 33° 20′ W.
Diff. of long. 396m. or 6 36 E.
Longitude in 26 44 W.

*To find the Difference of Longitude.*

| | |
|---|---|
| As co. sine course 38° 57′ | 9.89081 |
| Is to mer. diff. lat. 490 | 2.69020 |
| So is sine course 38° 57′ | 9.79840 |
| | 12.48860 |
| | 9.89081 |
| To diff. of long. 396.1 | 2.59779 |

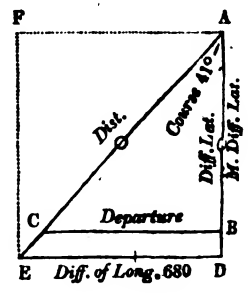
## CASE VIII.

*One Latitude, Course, and Difference of Longitude given, to find the Distance and Difference of Latitude.**

EXAMPLE. A ship from latitude 34° 29′ N. sails S. 41° W. till her difference of longitude is 680 miles: required her present latitude and distance sailed.

BY CONSTRUCTION.

Draw A D, and make A F perpendicular to it, and equal to the difference of longitude 680; draw F E parallel to A D, A E making an angle with A D equal to the course 41°, meeting F E in E, and E D parallel to F A; then A D will be the mer. diff. of latitude equal to 782; which subtracted from the mer. parts of the latitude left, gives the mer. parts of the latitude in: hence the latitude in is 23° 6′, and the diff. of latitude 683. Make A B equal to 683, and draw B C parallel to E D; then A C will be the distance measuring 905.




* This Case cannot be solved by Middle Latitude Sailing.

## BY CALCULATION.

*To find the Mer. Diff. of Latitude.*

| | |
|---|---|
| As radius | 10.00000 |
| Is to diff. of long. 680 | 2.83251 |
| So is co. tang. course 41° | 10.06084 |
| | 12.89335 |
| | 10.00000 |
| To mer. diff. lat. 782.3 | 2.89335 |

| | | | | |
|---|---|---|---|---|
| Lat. left | 34° 29′ N. | Mer. pts. | | 2207 |
| | | Mer. diff. lat. | | 782 |
| Lat. in | 23 6 N. | Mer. pts. | | 1425 |
| Diff. lat. | 11 23 | | | |
| | 60 | | | |
| Miles | 683 | | | |

*To find the Distance.*

| | |
|---|---|
| As co. sine course 41° | 9.87778 |
| Is to diff. of latitude 683 | 2.83442 |
| So is radius | 10.00000 |
| | 12.83442 |
| | 9.87778 |
| To the distance 905 | 2.95664 |

## EXAMPLES FOR EXERCISE.

1. Required the course and distance from the Cape of Good Hope, in latitude 34° 22′ S., and longitude 18° 24′ E., to the Island of St. Helena, in latitude 15° 55′ S., and longitude 5° 45′ W.

Answer. By Middle Latitude Sailing, the course is N. 49° 51′ W., and distance 1717 miles.*

By Mercator's Sailing, the course is N. 49° 40′ W., and distance 1710 miles.

2. Required the bearing and distance of Pernambuco, in latitude 8° 4′ S., and longitude 34° 53′ W., from Cape Verd, in latitude 14° 45′ N., and longitude 17° 32′ W.

Answer. By Middle Latitude Sailing, the course or bearing from Cape Verd to Pernambuco is S. 37° 12′ W., and the distance 1719 miles.

By Mercator's Sailing, the bearing is S. 37° 1′ W., and distance 1715 miles.

3. Required the course and distance from Cape Sierra Leone, in latitude 9° 30′ N., and longitude 13° 18′ W., to Cape St. Roque, in latitude 5° 28′ S., and longitude 35° 17′ W.

Answer. By Middle Latitude Sailing, the course is S. 55° 44′ W., and the distance 1595 miles.

By Mercator's Sailing, the course is S. 55° 40′ W., and distance 1592 miles.

4. Required the course and distance from Cape Palmas, in latitude 4° 24′ N., and longitude 7° 46′ W., to St. Paul de Loando, in latitude 8° 48′ S., and longitude 13° 8′ E.

* If the true middle latitude were found by the proportion given in the note at the bottom of page 85 (25° 50′), the answer would be the same as that by Mercator's Sailing.

Answer. By Middle Latitude Sailing, the course is S. 57° 42′ E., and the distance 1482 miles.

By Mercator's Sailing, the course is S. 57° 40′ E., and distance 1481 miles.

5. A ship from latitude 29° 47′ N., and longitude 24° 36′ W., sails S. S. W. ½ W. 320 leagues: required her present latitude and longitude.

Answer. By Middle Latitude Sailing, her latitude in is 16° 4′ N., and longitude in 33° 32′ W.

By Mercator's Sailing, her latitude in is 16° 4′ N., and longitude in 33° 33′ W.

6. A ship from latitude 2° 5′ N., and longitude 22° 30′ W., sails W. S. W. 256 leagues: required her present latitude and longitude; also her course and distance to St. Ann's Island, Maranham, in latitude 2° 15′ S., and longitude 43° 38′ W.

Answer. By Middle Latitude, or Mercator's Sailing, the latitude in is 2° 49′ S., longitude 34° 20′ W.; the course to St. Ann's Island N. 86° 30′ W., or W. ¼ N. nearly, and distance 556. 9 miles.

7. A ship from latitude 71° 20′ N., and longitude 28° 10′ E., sails E. S. E. until she arrives in the parallel of 70° N.: required her longitude in, with her direct course and distance to Cape Sweetnose, in latitude 68° 10′ N., and longitude 40° 3′ E.

Answer. By Middle Latitude Sailing, the longitude in is 37° 53′ E.; the course to Cape Sweetnose is S. 22° 53′ E. or S. S. E., and the distance 119. 4 miles.

By Mercator's Sailing, the longitude in is 37° 54′ E.; the course to Cape Sweetnose is S. 22° 44′ E. or S. S. E., and the distance 119. 3 miles.

8. Suppose a ship from latitude 9° 10′ N., and longitude 19° 32′ W., sails in the South-east quarter till she has made 415 miles of departure, and is by observation in lat. 2° 19′ S.: required her course steered, distance run, and longitude in.

Answer. By Middle Latitude, or Mercator's Sailing, her course steered is S. 31° 4′ E., distance run 804. 2, and longitude in 12° 36′ W.

9. A ship from latitude 46° 35′ N., and longitude 176° 42′ W., sails N. W. by W. ½ W. till she arrives in latitude 51° 18′ N.: required the distance run, and longitude in.

Answer. By Middle Latitude Sailing, her distance run is 600. 3 miles, and longitude in 169° 52′ E.

By Mercator's Sailing, her distance run is 600. 3 miles, and longitude in 169° 50′ E.

10. A ship from Table Bay (Cape of Good Hope), in latitude 33° 53′ S., and longitude 18° 19′ E., sails N. W. ½ W. till she arrives in latitude 27° 32′ S.: required her course and distance to St. Helena, in latitude 15° 55′ S., and longitude 5° 45′ W.

Answer. By Middle Latitude Sailing, the longitude in is 8° 22′ E.; the course to St. Helena N. 48° 28′ W., and distance 1051 miles.

By Mercator's Sailing, the longitude in is 8° 22′ E.; the course to St. Helena N. 48° 24′ W., and distance 1050 miles.

## OF COMPOUND COURSES.

### *To find the Difference of Longitude made good upon Compound Courses, by Middle Latitude and Mercator's Sailing.*

In the preceding Cases, both of Middle Latitude and Mercator's Sailing, we have always supposed the ship to sail on a direct course; but when she makes a compound course, the several courses are to be reduced to a single course, as in Traverse Sailing, and then the difference of longitude may be found either by Middle Latitude or Mercator's Sailing, as will appear by the following

EXAMPLE. Suppose a ship from latitude 52° 36′ N., and longitude 21° 45′ W., sails N. E. 36 miles; N. b. W. 14 miles; N. E. b. E. ½ E. 58 miles; N. b. E. 42 miles; and E. N. E. 29 miles: required her present latitude and longitude.

| Courses. | Distance. | Difference of Lat. | | Departure. | |
|---|---|---|---|---|---|
| | | N. | S. | E. | W. |
| N. E. | 36 | 25. 5 | | 25. 5 | |
| N. b. W. | 14 | 13. 7 | | | 2. 7 |
| N. E. b. E. ½ E. | 58 | 27. 3 | | 51. 2 | |
| N. b. E. | 42 | 41. 2 | | 8. 2 | |
| E. N. E. | 29 | 11. 1 | | 26. 8 | |
| | Diff. of Lat. | 118. 8 | | 111. 7 | 2. 7 |
| | | | | 2. 7 | |
| | | | Dep. | 109. 0 | |

The difference of latitude 118. 8, and departure 109. 0, give the course N. 42° 32′ E., and distance 161. 2, by Case VI. of Plane Sailing.

| | | | | | |
|---|---|---|---|---|---|
| Latitude left | 52° 36′ N. | Mer. pts. | 3724 | Longitude left | 21° 45′ W. |
| Diff. lat. 119, or | 1 59 N. | | | Diff. long. 184, or | 3 4 E. |
| Latitude in | 54 35 N. | Mer. pts. | 3925 | Longitude in | 18 41 W. |
| Sum of lats. 2) | 107 11 | Mer. diff. lat. | 201 | | |
| Mid. latitude | 53 35 | | | | |

*To find the Difference of Longitude.*

| *By the Middle Latitude.* | | *By Mercator.* | |
|---|---|---|---|
| As co. sine mid. lat. 53° 35′ | 9. 77353 | As co. sine course 42° 32′ | 9. 86740 |
| Is to departure 109 | 2. 03743 | Is to mer. diff. lat. 201 | 2. 30320 |
| So is radius | 10. 00000 | So is sine course 42° 32′ | 9. 82996 |
| | 12. 03743 | | 12. 13316 |
| | 9. 77353 | | 9. 86740 |
| To the diff. of long. 183. 6 | 2. 26390 | To the diff. of long. 184. 4 | 2. 26576 |

### BY INSPECTION.

The co. mid. latitude being about 36½°, first look for 36° as a course, and for the departure 109 in one of the dep. columns, against the nearest to which is 186 in a dist. column; then look for the departure 109 in the page with 37° at the top, opposite which stands 181 in a dist. column; the sum of this and 186 is 367, the half of which is 183. 5, the difference of longitude by Middle Lat. Sailing: or, the course being 42½°, look in the pages with 42° and 43° at the top for the mer. diff. of latitude 201 in a lat. column, against the nearest to which will be 181. 3 and 187. 5 in the corresponding dep. columns; the sum of these is 368. 8, half of which is 184. 4, the diff. of longitude by Mercator's Sailing.

The above method is that generally practised at sea in estimating the difference of longitude made good in a day's run, being considered sufficiently exact for the distance sailed by a ship in that time; but when the distances are considerable, especially in high latitudes, it is more accurate to estimate the difference of longitude made upon each course and distance, according to the following rules.

I. *By Middle Latitude.* To the Traverse Table annex a Longitude Table, divided into six columns; the first is to contain the latitude left, and the several latitudes the ship is in at the end of each course and distance, estimated by the latitudes left, and differences of latitude in the Traverse Table; the second, the sums of each following pair of latitudes; the third, half the sums of middle latitudes; the fourth, the complements of the middle latitude; and the fifth and sixth columns are to contain the differences of longitude. Having found the co. mid. latitudes, with these and their corresponding departures in the Traverse Table, find the differences of longitude, and place them in the east or west columns, according to the name of the departure; then the difference of the sums of these columns will be the difference of longitude made good, of the same name with the greater.

II. *By Mercator.* To the Traverse Table annex a Longitude Table, consisting of five columns; the first is to contain the latitude left, and the latitudes of the ship at the end of each course and distance; the second, the meridional parts corresponding to each latitude; the third, the meridional differences of latitude; and the fourth and fifth, the differences of longitude.

Having found the meridional differences of latitude, with these and the courses in the Traverse Table, find the corresponding differences of longitude, which place in the east or west columns, according as the course is easterly or westerly; then the difference between the sums of these columns will be the difference of longitude made good upon the whole Traverse, of the same name with the greater.

NOTE. When the course is north or south, there is no difference of longitude; and when it is east or west, the difference of longitude must be found, as in Case II. of Parallel Sailing.

The differences of longitude may be found by any of the methods given in the Sailings; but in the following Example we have used Inspection only.

## EXAMPLE.

A ship from Hangcliff, in latitude 60° 9′ N., and longitude 1° 7′ W., sailed as follows, *viz.* N. E. b. N. 69 miles; N. N. E. 48 miles; N. b. W. ½ W. 78 miles; N. E. 108 miles; and S. E. b. E. 50 miles: required her latitude and longitude in.

### BY MIDDLE LATITUDE.

**TRAVERSE TABLE.**

| Courses. | Dist. | Diff. Lat. N. | Diff. Lat. S. | Departure. E. | Departure. W. |
|---|---|---|---|---|---|
| N. E. b. N. | 69 | 57.4 | | 38.3 | |
| N. N. E. | 48 | 44.4 | | 18.4 | |
| N. b. W. ½ W. | 78 | 74.6 | | | 22.6 |
| N. E. | 108 | 76.4 | | 76.4 | |
| S. E. b. E. | 50 | | 27.8 | 41.6 | |
| | | 252.8 | 27.8 | 174.7 | 22.6 |
| | | 27.8 | | 22.6 | |
| | D. lat. | 225.0 | | 152.1 | Dep. |

Course N. 34° E. and Distance 272 miles.

**LONGITUDE TABLE.**

| Lats. | Sums. | Mid. Lats. | Co. Mid. Lats. | Diff. Long. E. | Diff. Long. W. |
|---|---|---|---|---|---|
| 60° 9′ | | | | | |
| 61 6 | 121 15 | 60 37 | 29 23 | 78 | |
| 61 50 | 122 56 | 61 28 | 28 32 | 38 | |
| 63 5 | 124 55 | 62 27 | 27 33 | | 49 |
| 64 21 | 127 26 | 63 43 | 26 17 | 174 | |
| 63 53 | 128 14 | 64 7 | 25 53 | 95 | |
| | | | | 385 | 49 |

Longitude left ..... 1° 7′ W.
Diff. long. 336, or 5 36 E.
Longitude in... 4 29 E. — 336

### BY MERCATOR.

**TRAVERSE TABLE.**

| Course. | Dist. | Diff. Lat. N. | Diff. Lat. S. | Departure. E. | Departure. W. |
|---|---|---|---|---|---|
| N. E. b. N. | 69 | 57.4 | | 38.3 | |
| N. N. E. | 48 | 44.4 | | 18.4 | |
| N. b. W. ½ W. | 78 | 74.6 | | | 22.6 |
| N. E. | 108 | 76.4 | | 76.4 | |
| S. E. b. E. | 50 | | 27.8 | 41.6 | |
| | | 252.8 | 27.8 | 174.7 | 22.6 |
| | | 27.8 | | 22.6 | |
| | D. lat. | 225.0 | | 152.1 | Dep. |

Course N. 34° E. and Distance 272 miles.

**LONGITUDE TABLE.**

| Lats. | Mer. Parts. | Mer. D. Lats. | Diff. Long. E. | Diff. Long. W. |
|---|---|---|---|---|
| 60° 9′ | 4545 | | | |
| 61 6 | 4662 | 117 | 78.3 | |
| 61 50 | 4754 | 92 | 38.3 | |
| 63 5 | 4916 | 162 | | 49.1 |
| 64 21 | 5088 | 172 | 172.0 | |
| 63 53 | 5023 | 65 | 97.3 | |
| | | | 385.9 | 49.1 |

Longitude left... 1° 7′ W.
Diff. long. 337, or 5 37 E. — 49.1
Longitude in... 4 30 E. — 336.8

The longitude of the ship, according to the first method, is 4° 17′ E. by Middle Latitude, and the same by Mercator's Sailing, differing from the above 12 and 13 miles; but as we have already observed, it is seldom necessary to use the latter methods at sea.

# OBLIQUE SAILING.

OBLIQUE SAILING is the application of oblique-angled plane triangles to various cases at sea; as in coasting along shores, approaching or leaving the land, surveying coasts or harbours, &c.

In this kind of sailing, *to set an object*, means to observe what rhumb, or point of the compass, is directed to it; and the *bearing* of an object is the rhumb on which it is seen; also the bearing of one place from another, is reckoned by the name of the rhumb passing through those two places: hence the bearing of two places from each other are upon opposite points of the compass; thus, if one place bear E. N. E. from another, the latter will bear W. S. W. from the former, being in the same line, but in opposite directions.

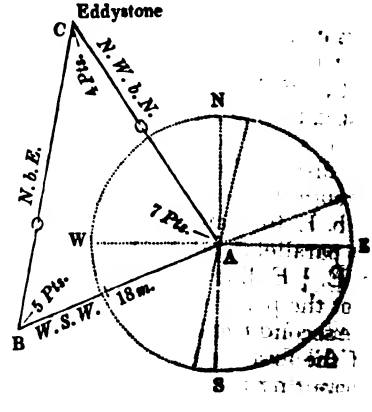
A great variety of Examples might be given in this Sailing; but as they would rather tend to exercise the learner in Trigonometry than answer any direct purpose, we shall select those only that appear to be useful in practice.

## EXAMPLE I.

Sailing down the Channel, I observed the Eddystone bear N. W. b. N.; and after sailing W. S. W. 18 miles, I found it bore from me N. b. E.: required the distance of the ship from the Eddystone at both stations.

### BY CONSTRUCTION.

Describe the circle N. W. S. E., to represent the compass, and draw the diameters W. E. and N. S. at right angles to each other; draw the N. W. b. N., W. S. W., and N. b. E. rhumb lines, and on the W. S. W. line lay off 18 from A to B, taken from any scale of equal parts; through B draw B C parallel to the N. b. E. line, meeting the N. W. b. N. line A C in C; then will A represent the place of the ship at her first station, B her place at the second station, and C the place of the Eddystone; A C will be the ship's distance from the Eddystone at the first station, measuring 21 miles, and B C the distance at the second station, measuring 25 miles.



### BY CALCULATION.

In the triangle A B C are given the side A B 18 miles, the angle C A B equal to 7 points, the measure of the arch contained between the N. W. b. N. and the W. S. W. lines; the angle A B C equal to 5 points, the interval between the N. b. E. and the E. N. E. line (being the opposite to the W. S. W. rhumb); and the angle B C A equal to 4 points, the interval between the S. b. W. and the S. E. b. S. lines; to find the sides A C and B C.

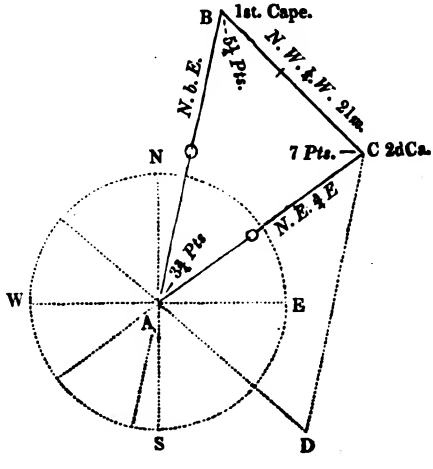
| *To find the Side* A C. | | *To find the Side* B C. | |
|---|---|---|---|
| As sine of angle C 4 points | 9. 84949 | As sine of angle C 4 points | 9. 84949 |
| Is to the side A B 18 | 1. 25527 | Is to the side A B 18 | 1. 25527 |
| So is sine angle B 5 points | 9. 91985 | So is sine angle A 7 points | 9. 99157 |
| | 11. 17512 | | 11. 24684 |
| | 9. 84949 | | 9. 84949 |
| To the side A C 21. 17 | 1. 32563 | To the side B C 24. 97 | 1. 39735 |

Hence the distance of the Eddystone from the ship's first station is 21. 17 miles, and from the second station 24. 97, or 25 miles nearly.

### EXAMPLE II.

Coasting along shore, I observed two Capes: the first bore N. b. E., and at the same time the second bore N. E. $\frac{3}{4}$ E.; now, by the Chart, these Capes bear from each other N. W. $\frac{1}{4}$ W., and S. E. $\frac{1}{4}$ E. (by compass), distant 21 miles: required my distance from both places at that time.

### BY CONSTRUCTION.




Having drawn the compass N.W. S.E., the centre of which is to represent the ship's place, draw the N. b. E. and N. E. $\frac{3}{4}$ E. rhumb lines A B and A C, being the bearings of the Capes from the ship; draw likewise the N. W. $\frac{1}{4}$ W. and S. E. $\frac{1}{4}$ E. line, the bearing of the Capes from each other, on which from A to D lay off 21 miles, the distance between the Capes; through D draw D C parallel to the N. b. E. line, and through C draw C B parallel to the N. W. $\frac{1}{4}$ W. and S. E. $\frac{1}{4}$ E. line; then B will represent the place of the first Cape, C the second Cape, A B the distance of the first Cape from the ship, measuring 31 miles, and A C the distance of the second Cape, measuring 27 miles.

BY CALCULATION.

In the triangle A B C are given the angle B A C $3\frac{3}{4}$ points, the arch between the N. b. E. and N. E. $\frac{3}{4}$ E. lines; the angle A B C $5\frac{1}{4}$ points, the interval between the S. b. W. and S. E. $\frac{1}{4}$ E. lines; and the angle A C B 7 points, the interval between the N. W. $\frac{1}{4}$ W. and S. W. $\frac{3}{4}$ W. lines; and the side B C 21 miles; to find the sides A B and A C.

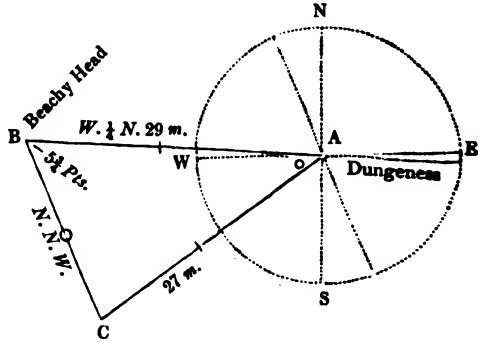
| *To find the Side* A B. | | *To find the Side* A C. | |
|---|---|---|---|
| As sine angle A $3\frac{3}{4}$ points | 9. 82708 | As sine angle A $3\frac{3}{4}$ points | 9. 82708 |
| Is to the side B C 21 | 1. 32222 | Is to the side B C 21 | 1. 32222 |
| So is sine angle C 7 points | 9. 99157 | So is sine angle B $5\frac{1}{4}$ points | 9. 93335 |
| | 11. 31379 | | 11. 25557 |
| | 9. 82708 | | 9. 82708 |
| To the side A B 30. 67 | 1. 48671 | To the side A C 26. 82 | 1. 42849 |

Hence the distance of the ship from the first Cape is 30. 67 miles, and from the second Cape 26. 82, or 27 miles nearly.

EXAMPLE III.

Being close in with Dungeness, I ran 27 miles on a direct course to the westward, and then found Beachy Head bear N. N. W.; now the bearing of Beachy Head from Dungeness (by compass) is W. $\frac{1}{4}$ N., and the distance 29 miles: required the course steered, and the distance of the ship from Beachy Head.

BY CONSTRUCTION.




Describe a circle, and divide it into 4 equal parts by the diameters N. S. and W. E., the extremes of which will represent the cardinal points of the compass; and the centre of the circle the place the ship sailed from (Dungeness); draw the W. $\frac{1}{4}$ N. line A B equal to 29 miles, then will B represent the place of Beachy Head: through B draw B C parallel to the N. N. W. line, and with the distance run, 27 miles in the compasses, set one foot in A, and with the other describe an arch cutting B C in C, and draw the line A C: then will C represent the ship's place, B C the distance of the ship from Beachy Head, measuring 19 miles, and the angle S A C the course steered from the south, measuring 59° 39′.

BY CALCULATION.

In the triangle A B C are given the side A B, equal to 29 miles; the side A C 27 miles; and the angle A B C $5\frac{3}{4}$ points, the interval between E. $\frac{1}{4}$ S. and S. S. E.; to find the angle B A C, and the side B C.

*To find the Angle* BAC.

| | | | | |
|---|---|---|---|---|
| As the side AC 27 | 1.43136 | Angle BCA | 76° | 9′ |
| Is to sine of angle ABC 5¾ points | 9.95616 | Angle ABC 5¾ pts. or | 64 | 41 |
| So is the side AB 29 | 1.46240 | Sum | 140 | 50 |
| | 11.41856 | | 180 | 00 |
| | 1.43136 | Angle BAC | 39 | 10 |
| To sine of angle BCA 76° 9′ * | 9.98720 | | | |

*To find the Side* BC.

| | |
|---|---|
| As sine of angle ABC 5¾ points... | 9.95616 |
| Is to the side AC 27 ..... | 1.43136 |
| So is sine of angle BAC 39° 10′... | 9.80043 |
| | 11.23179 |
| | 9.95616 |
| To the side BC 18.86 ..... | 1.27563 |

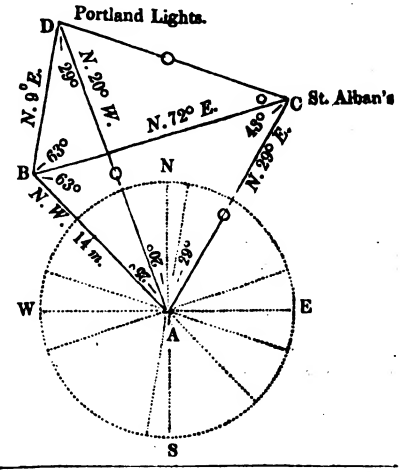
Now the bearing of AB, which is W. ¼ N. or W. 2° 49′ N., subtracted from the angle BAC 39° 10′, gives the bearing of AC W. 36° 21′ S.; hence the course steered is S. 53° 39′ W. or S. W. ¾ W., and the distance of the ship from Beachy Head is 18.86, or 19 miles nearly.

## EXAMPLE IV.

At noon St. Alban's Head bore N. 29° E., and Portland Lights N. 20° W.; and running N. W., at the rate of 7 knots an hour, at 2 P. M. St. Alban's Head bore N. 72° E., and Portland Lights N. 9° E.: required the bearing and distance of Portland Lights from St. Alban's Head.

### BY CONSTRUCTION.

Draw the compass as before, and let the centre A represent the first station, from which draw the first bearing AC, N. 29° E., and the second bearing AD, N. 20° W.; also draw the N. W. line AB equal to 14 miles, the distance run in 2 hours; then will B represent the second station; through B draw BC parallel to N. 72° E., and BD parallel to N. 9° E., meeting the lines AC and AD in C and D, and join DC; then will C represent St. Alban's Head, D Portland Lights, and CD their distance, measuring 18.29 miles, the bearing of which will be N. 70½° W., or W.N.W. ¼ W.




* If the above angle BCA be considered obtuse, or 103° 51′, the side BC would then be 5.938. (See Rules, page 45).

## BY CALCULATION.

In the triangle A B C are given the side A B 14 miles, the angle A C B equal to 43°, the interval between S. 72° W. and S. 29° W.; and the angle A B C equal to 63°, the interval between N. 72° E., or E. 18° N. and S. E., or S. E. 45° S.; to find the side A C.

| | |
|---|---|
| As sine of angle A C B 43° ..... | 9. 83378 |
| Is to the side A B 14 ..... | 1. 14613 |
| So is sine of angle A B C 63° ..... | 9. 94988 |
| | 11. 09601 |
| | 9. 83378 |
| To the side A C 18. 29 ..... | 1. 26223 |

In the triangle A B D are given the side A B 14 miles, the angle A D B equal to 29°, the interval between S. 20° E. and S. 9° W.; the angle A B D equal to 126°, the interval between N. 9° E., or E. 81° N., and S. E. or S. 45° E.; to find the side A D.

| | |
|---|---|
| As sine of angle A D B 29° ..... | 9. 68557 |
| Is to the side A B 14m. ..... | 1. 14613 |
| So is sine of angle A B D 126° ..... | 9. 90796 |
| | 11. 05409 |
| | 9. 68557 |
| To the side A D 23. 36 ..... | 1. 36852 |

In the triangle A C D are given the side A C 18. 29; the side A D 23. 36; and the included angle C A D equal to 49°, the interval between N. 29° E. and N. 20° W.; to find the angle A C D, and the side C D.

*To find the Angle* A C D.

| | | | | |
|---|---|---|---|---|
| Side A D | 23. 36 | | As sum of the sides A C, A D, 41. 65 | 1. 61962 |
| Side A C | 18. 29 | | Is to their difference 5. 07 | 0. 70501 |
| Sum | 41. 65 | | So is tang. of half the sum of angles A D C, D C A } 65° 30′ | 10. 34130 |
| Difference | 5. 07 | | | 11. 04631 |
| | | 180° | | 1. 61962 |
| Angle C A D | | 49 | | |
| | | | To tang. of half their diff. 14 57 | 9. 42669 |
| Sum of A D C & D C A | | 131 | | |
| Half | | 65 30′ | Sum gives the angle A C D 80 27 | |

*To find the Side* C D.

| | |
|---|---|
| As sine of angle A C D 80° 27′ ..... | 9.99394 |
| Is to the side A D 23.36 ..... | 1.36847 |
| So is sine of angle C A D 49° ..... | 9.87778 |
| | 11.24625 |
| | 9.99394 |
| To the side C D 17.88 ..... | 1.25231 |

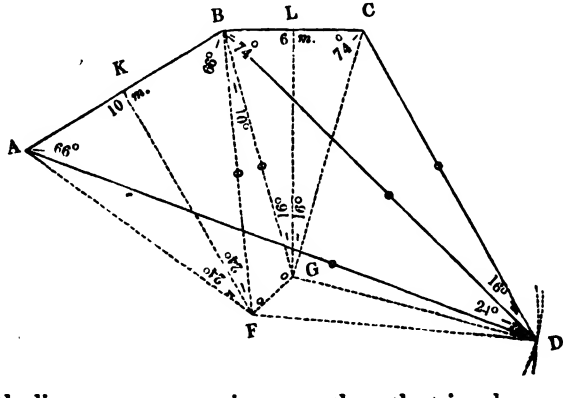
Now the angle A C D 80° 27′ added to 29°, the bearing of A C from the south, gives the bearing of C D, S. 109° 27′ W., which, subtracted from 180°, leaves the bearing N. 70° 33′ W. or W. N. W. ¼ W. nearly: hence the bearing of Portland Lights from St. Alban's Head is W. N. W. ¼ W. (by compass), and the distance 18 miles nearly.

NOTE. In this manner the mutual bearings and distances of any number of points may be ascertained; but in practice it is more expeditious, and in general sufficiently exact, to construct the figure on a proper scale, and then measure off the several parts.

## EXAMPLE V.

Coasting along shore, I struck upon a shoal, and wanting to ascertain its situation exactly, I took angles with my sextant, subtended by three objects on shore, as A, B, and C, whose relative positions were as follow: the distance from A to B was 10 miles, from B to C 6 miles, and the angle A B C 150°; now the angle, measured at the ship, between A and B, was 24°, and between B and C 16°: required the distance of D, the ship's place, from each object.

### BY CONSTRUCTION.




Draw the line A B, and make it equal to 10; at B make the angle A B C 150°, and draw the line B C equal to 6.

Bisect the line A B (Problem I. Geom.), and draw the line K F, which will be perpendicular to A B; make the angles F A B and F B A each equal to 66° (the complement of the given angle A D B 24°), and draw the lines A F, B F, meeting at F; then, the triangles A K F and B K F being right-angled at K, the angles A F K and B F K will be each equal to 24°, and the angle A F B at K 48°, or double the given angle A D B.

In like manner bisect the line B C, and draw the line L G; make the angles G B C and G C B each equal to 74° (the complement of the given angle B D C 16°), and draw the lines B G, C G, meeting at G; then will the angle B G C be 32°, or double the angle B D C.

With the radius A F, or B F, from F, draw an arch at D.

With the radius G B, or G C, from G draw an arch, cutting the former one at the point D,* which will be the ship's place.

Draw the lines C D, B D, and A D, which will be the distances required; that is C D will measure 15. 17, B D 18. 88, and A D 23. 66, the angle A D B measuring 24°, and the angle B D C 16°.†

Draw the lines F G, F D, and G D.

## BY CALCULATION.

In the isoceles triangle A F B are given the side A B 10, the angles A F B 48°, and F A B 66°, to find the side F B 12. 29, equal to the sides F A or F D.

Or, in the right-angled triangle B K F are given the side B K 5 (the half of A B), and the angle B F K 24°, to find the side B F 12. 29, equal to the sides F A or F D.

In the isoceles triangle B G C are given the side B C 6, the angles G B C 74°, and B G C 32°, to find the side G B 10. 88, equal to the sides G C or G D.

Or, in the right-angled triangle B L G are given the side B L 3 (the half of B C), and the angle B G L 16°, to find the side G B 10. 88, equal to the sides G C or G D.

The angle A B F 66°, added to the angle G B C 74°, and their sum 140°, subtracted from the angle A B C 150°, the remainder will be the angle F B G 10°.

In the triangle F B G are given the side F B 12. 29, the side G B 10. 88, and the angle F B G 10°, to find the angles B F G 50° 11′, and B G F 119° 49′.

The triangles F B G and F D G are *identical*, that is, mutually equal in all their parts; the side F B being equal to the side F D 12. 29, G B to G D 10. 88, and F G common to both triangles; therefore, the angle B F G is equal to the angle G F D 50° 11′, F G B to F G D 119° 49′, and F B G to F D G 10°.

The angle B F G 50° 11′, added to the angle G F D 50° 11′, their sum will be the angle B F D 100° 22′.

---

* When the arches at D intersect each other at very acute angles (as in the present example), it will be difficult to determine exactly the point of intersection; the point D may in such case be found, independent of the arches, as follows:—From B let fall a perpendicular on F G, produced if necessary, and draw the line B D of an indefinite length; then produce the lines B F and B G to twice their lengths; through the ends of these lines draw a line meeting the line B D, and it will intersect it at the point D.

† In Euclid, Book III., Prop. XX., it is demonstrated that "the angle at the centre of a circle is double the angle at the circumference upon the same base, that is, upon the same part of the circumference;" therefore, the angle A D B is half the angle A F B, and the angle B D C is half the angle B G C.

In the isoceles triangle B F D, the angle B F D 100° 22′, subtracted from 180° (the sum of the three angles), will give the remainder 79° 38′, the half of which, 39° 49′, will be the angle F B D or F D B.

In the isoceles triangle B F D are given the sides F B and F D 12. 29, the angle B F D 100° 22′, and the angle F B D or F D B 39° 49′, to find the side B D 18. 88.

The angle F B D 39° 49′, added to the angle E B A 66°, their sum will be the angle A B D 105° 49′.

In the triangle A B D are given the side A B 10, the angle A B D 105° 49′, and the angle A D B 24°, to find the side A D 23. 66.

The angle A B D 105° 49′, subtracted from the angle A B C 150°, the remainder will be the angle C B D 44° 11′.

In the triangle B D C are given the side B C 6, the angle C D B 16°, and the angle C B D 44° 11′, to find the side C D 15. 17.

Hence the distance of the ship at D from A is 23. 66 miles, from B 18. 88 miles, and from C 15. 17 miles.

NOTE. The learner is left to work the proportions by the Rules in Trigonometry, the answers to which are given above; but, as observed in the last example, it will in general be sufficiently exact to construct the figure, and measure off the distances required.

In this manner rocks, buoys, shoals, or soundings may be accurately laid down on adjacent coasts, when the relative positions of three stations on shore are ascertained.

## EXAMPLES FOR EXERCISE.

1. Running down Channel, and wanting to take my departure from the Lizard, at 2 h. P. M. I observed it bear from me N. b. W.; and after sailing W. b. N. ¼ N., at the rate of 8 knots per hour, at 3 h. 30 m. P. M. it bore from me N. N. E. ½ E.: required my distance from the Lizard at the time of taking the second bearing.

Answer. The distance 17. 1 miles.

2. Entering the River Thames by night, I observed Orfordness Lights bear from me N. b. E. ¼ E., and the Sunk Light W. ¼ S., the former bearing from the latter N. E. b. N. ¼ E., distant 18 miles: required my distance from each of the Lights.

Answer. Distance from Orfordness Lights 14. 54 miles, and from the Sunk Light 7. 198 miles.

3. Being off the Burlings (on the Coast of Portugal), I ran 34 miles on a direct course between the south and west, and then observed the Rock of Lisbon bearing from me S. by E. ½ E., the Rock bearing from the Burlings S. b. W. ¾ W. (by compass), and their distance being 43 miles: required the course steered, and my distance from the Rock.

Answer. The ship's course was S. 32° W. or S. S. W. ¾ W. nearly, and my distance from the Rock 12. 17 miles.

4. Sailing between two small islands, I observed the first bear from me S. W. b. W. $\frac{3}{4}$ W., and the second E. S. E.; after running S. b. W. $\frac{1}{4}$ W. 15 miles, the first bore from me N. W. b. W., and the second E. $\frac{1}{4}$ N.: required the bearings, and distance between the islands.

Answer. The first island bore from the second N. 84° 28′ W., the second from the first S. 84° 28′ E., and their distance was 42. 49 miles.

5. Two ships, A and B, sail from the same port C; A sails N. E. b. N. 84 miles, and B sails S. E. 76 miles: required their bearings, and distance from each other.

Answer. Bearing of A from B N. 3° 16¼′ W., of B from A S. 3° 16¼′ E., and their distance 123. 8 miles.

6. Being off the Coast of South America, in latitude 47° 4′ 30″ S., and longitude 65° 26′ W., I found the (true) bearing of Cape Blanco to be W. 20° S., and after running S. 12° 30′ W. 32 miles, the Cape bore N. 34° W.: required the latitude and longitude of the Cape.

Answer. The latitude of Cape Blanco is 47° 12′ 42′ S., and longitude 65° 59′ W.

7. Wanting to know the distance of a ship at anchor from the shore, I chose two stations, A and B, that were distant from each other 2. 5 miles. From the station at A, I took with a sextant the angle subtended by the station at B and the ship, and found it to be 64° 15′; then from the station at B, I found the angle between the station A and the ship, 73° 55′: required the distance of the ship from both stations.

Answer. The distance of the ship from the station at A was 3. 602, and from the station at B, 3. 376 miles.

8. Sailing along a coast, I observed two objects, a church and a mill, in one, the church being the nearer object; and at the same time I measured the angle subtended at the ship by the church and a tower on the coast, and found it to be 25° 36′; now, by a chart, the distance from the church to the tower was 1. 5 mile, from the church to the mill . 75 of a mile, and from the mill to the tower 1. 9 mile: required the distance of the ship from the church and the tower.

Answer. The distance of the ship from the church was 3. 459 miles, and from the tower 3. 246 miles.

9. From Winterton Lighthouse to Hasborough High Lighthouse the bearing and distance are N. 41° 40′ W. 8. 54 miles, and from the latter to Cromer Lighthouse N. 51° 6′ W. 9. 64 miles; from Hasborough Light-vessel, the angle between Winterton and Hasborough Lighthouses, measured by a sextant, was 28° 35′, and between the latter and Cromer Light 59° 8′: required the bearings and distances from the light-vessel to the three above-mentioned lighthouses.

Answer. From Hasborough Light-vessel to Cromer Lighthouse the bearing and distance are S. 76° 7′ W. 10.42 miles; from the same to Hasborough Lighthouse, S. 16° 59′ W. 8. 943 miles; and from the same to Winterton Lighthouse, S. 11° 36′ E. 15. 24 miles.

NOTE. The above is worked similar to Example V., page 117.

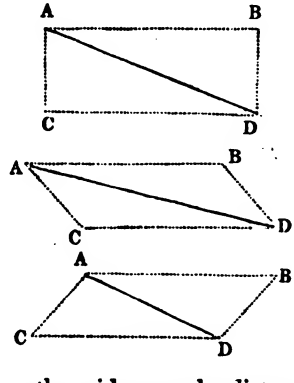
# CURRENT SAILING.

CURRENT SAILING is the method of determining the true course and distance of a ship, when her own motion is affected and combined with that of a current.

A CURRENT is a progressive motion of the water, causing all floating bodies to move that way towards which the stream is directed. The *setting of a current* is that point of the compass towards which the water runs; and its *drift* is the rate at which it runs per hour, or in any other given time.

The most usual method of ascertaining the set and drift of an unknown current is to take a boat, in calm weather, a small distance from the ship, and, being provided with a half-minute glass, a log, a heavy iron pot, or some heavy piece of metal, and a small boat-compass, to let down the pot, or weight, by a rope fastened to the boat's stem, to the depth of about 100 fathoms, by which the boat will remain nearly as steady as at anchor; then the log being hove, its bearing will be the setting of the current, and the number of knots run out in half-a-minute will be its drift per hour.

The current being known, it remains to apply its effects on a ship's way, which will depend on the direction and velocity of both, with regard to each other. If a ship sail in the direction of the current, it is evident that the velocity of the current must be added to that of the vessel; if her course be directly against the current, their difference will be the ship's true velocity; but if a ship's course be oblique to the current, her direction by the compass will be compounded with that of the current; that is, she will proceed in the diagonal of the parallelogram formed according to the two lines of direction, and will describe, or pass over, that diagonal in the same time in which she would have described either of the sides by the separate velocities. For let A B C D be a parallelogram, the diagonal of which is A D. Now if the wind alone would drive the ship from A to B, in the same time the current alone would drive it from A to C, then as the wind neither helps nor hinders the ship from coming towards the line C D, the current will bring it there in the same time as if the wind did not act; and as the current neither helps nor hinders the ship from coming towards the line B D, the wind will bring it there in the same time as if the current did not act. Therefore, the ship must, at the end of that time, be found in both those lines, that is, in their meeting D: consequently, the ship must have passed from A to D in the diagonal line A D. Hence the ship's true distance will be the third side of a triangle, whereof the other sides are the distance by the log and the drift of the current, and the true course will be the angle between that third side and the meridian.

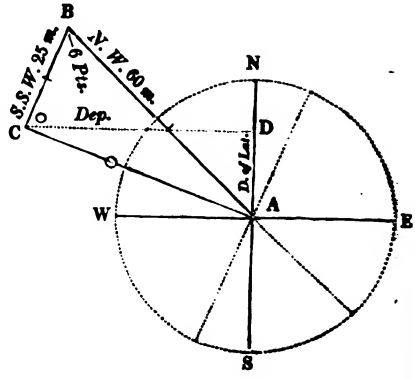


## EXAMPLE I.

**A ship sails N. W. 60 miles, in a current that sets S. S. W. 25 miles in the same time: required her course and distance made good.**

### BY CONSTRUCTION.

Having drawn the compass, set off 4 points from the North towards the West, and draw the N. W. line A B, which make equal to 60 miles, the distance run by the log; through B draw B C parallel to the S. S. W. and N. N. E. line, and equal to 25 miles, the set and drift of the current: now A C being joined, will be the true distance, measuring 55. 48 miles, and the angle N A C the true course N. 69° 36′ W.




### BY CALCULATION.

In the triangle A B C are given the side A B 60, the side B C 25, and the included angle A B C 6 points, or 67° 30′, to find the angle B A C and the side A C.

*To find the Angle* B A C.

| | | | |
|---|---|---|---|
| Side A B... 60 | | As the sum of A B, B C 85 ..... | 1. 92942 |
| Side B C... 25 | | Is to their difference 35 ..... | 1. 54407 |
| Sum ..... 85 | | So is tang. of half the sum of angles A and C ..... 56° 15′ ..... | 10. 17511 |
| Difference 35 | | | 11. 71948 |
| | 180° 00′ | | 1. 92942 |
| Angle B ..... | 67 30 | | |
| Sum of ang. A & C | 112 30 | To tang. of half the diff. ... 31 39 | 9. 78976 |
| Half ..... | 56 15 | Diff. gives angle B A C..... 24 36 | |
| | | Angle N A B ..... 45 0 | |
| | | Sum gives the angle N A C 69 36 | |

*To find the Side* A C.

| | |
|---|---|
| As sine of angle A 24° 36′..... | 9. 61939 |
| Is to the side B C 25m. ..... | 1. 39794 |
| So is sine of angle B 67° 30′ ..... | 9. 96562 |
| | 11. 36356 |
| | 9. 61939 |
| To the side A C 55. 48 ..... | 1. 74417 |

Hence the course made good, N A C, is N. 69° 36′ W. or W. N. W. ¼ W. nearly, and the distance A C 55 miles and a half.

But the most usual, and the easiest way of allowing for the effects of a current, is to consider the setting and drift as a course and distance, and enter it accordingly in a Traverse Table; then the whole difference of latitude and departure will give the true course and distance. By this method the preceding example is thus worked:

| Courses. | Distance. | Difference of Lat. | | Departure. | |
|---|---|---|---|---|---|
| | | N. | S. | E. | W. |
| N. W. | 60 | 42. 4 | | | 42. 4 |
| S. S. W. (Current.) | 25 | | 23. 1 | | 9. 6 |
| | | 23. 1 | | | |
| | Diff. of Lat. | 19. 3 | | Dep. | 52. 0 |

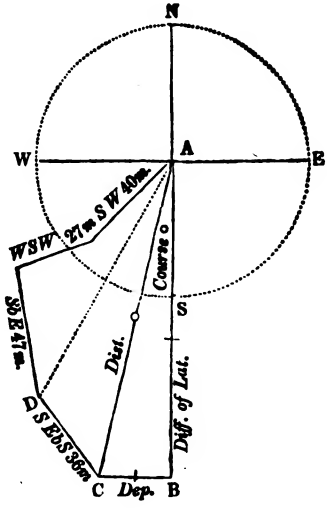
The difference of latitude A D 19. 3, and the departure C D 52, give the course D A C, N. 69° 38′ W., and the distance A C 55. 46, by Case VI. in Plane Sailing.

## EXAMPLE II.

Suppose a ship in 24 hours sail as follows: S. W. 40 miles, W S. W. 27 miles, and S. by E. 47 miles, being all that time in a current setting S. E. b. S., at the rate of 1½ mile per hour: required her direct course, and distance made good.

### BY CONSTRUCTION.

Draw the compass, and lay off the several courses and distances, as in Traverse Sailing; then will D represent the place of the ship by the log: from D draw D C parallel to the S. E. by S. line, and equal to 36 miles, for the setting and drift of the current in 24 hours; then will C be the ship's true place, the angle B A C the true course, measuring 11° 50′, A C the distance 117, A B the difference of latitude 114. 6, and B C the departure 24 miles.



## BY CALCULATION.

With the several courses and distances by the log, the direct course D A S and distance A D may be found; then, in the triangle A D C will be given the angle A D C, and the sides A D, D C, to find the angle D A C, which subtracted from D A S, will give the true course S A C, and the side A C the true distance. But the solution of this triangle we shall leave to the learner, and work the question, by allowing for the set and drift of the current in the Traverse Table.

| Courses. | Distance. | Difference of Lat. | | Departure. | |
|---|---|---|---|---|---|
| | | N. | S. | E. | W. |
| S. W. | 40 | | 28. 3 | | 28. 3 |
| W. S. W. | 27 | | 10. 3 | | 24. 9 |
| S. b. E. | 47 | | 46. 1 | 9. 2 | |
| S. E. b. S. | 36 | | 29. 9 | 20. 0 | |
| (Current.) | | | | | |
| | | Diff. lat. | 114. 6 | 29. 2 | 53. 2 |
| | | | | | 29. 2 |
| | | | | Dep. | 24. 0 |

The difference of latitude A B 114. 6, and the departure B C 24. 0, give the true course C A B S. 11° 50′ W., or S. b. W., and the distance A C 117. 1 miles, by Case VI. in Plane Sailing.

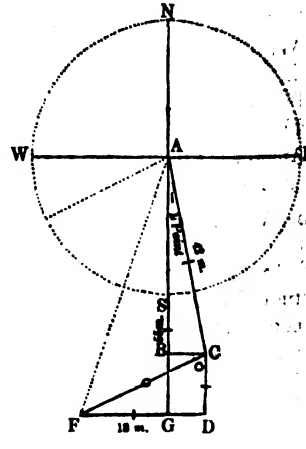
## EXAMPLE III.

A ship sailing in a current has, by her Reckoning, run S. b. E. 42 miles; but by Observations, finds she has made 55 miles of southing, and 18 miles of westing: required the set and drift of the current.

### BY CONSTRUCTION.

Having drawn the compass, set off 1 point from the South towards the East, and draw the S. b. E. line A C, which make equal to 42 miles; through C draw the line C B parallel to the East and West, then will A B be the difference of latitude 41. 19, and B C the departure 8. 19, made by the log.

From A to G lay off 55, the diff. of lat. by Observation, and through G draw a line parallel to the East and West; from G towards F lay off 18, the true departure, and draw the line C F. From C draw a line parallel to A G, meeting the line F G produced, in D: then the angle F C D will be the setting of the current, measuring S. 62° 12′ W.; and the side C F the drift, 29. 59 miles.



## BY CALCULATION.

In the triangle A B C are given the course B A C 1 point, and the distance A C 42 miles, to find the difference of latitude A B 41. 19, and the departure B C 8. 19.

Subtract A B 41. 19 S., the difference of latitude by the log, from A G 55 S., the difference of latitude by observation; and the remainder B G 13. 81 will be what the ship is to the southward of her reckoning.

To the departure B C (equal to G D) 8. 19 E., add the departure F G 18 W., and the sum F D 26. 19 will be what the ship is to the westward of her account.

The difference of latitude C D (equal to B G) 13. 81, and the departure D F 26. 19, give the angle or course S. 62° 12′ W., and the side C F, or distance 29. 59, for the setting and drift of the current.

## EXAMPLES FOR EXERCISE.

1. A ship sails by her log N. W. b. N. 72 miles, in a current that sets W. N. W. 36 miles in the same time: required her course and distance, corrected for the effect of the current.

Answer. The course made good is N. 44° 51′ W., or N. W. nearly, and distance 104 miles.

2. A ship sails E. b. N. 7. 5 knots an hour, in a current setting S. W. 4 knots an hour: what will be her course and distance made good in 24 hours?

Answer. The course will be S. 73° 12′ E., or E. S. E. ½ E. nearly, and the distance 113. 5 miles.

3. A ship sailing at the rate of 9 knots an hour, and wanting to double a Cape bearing from her N. W. b. W., finds she is in a current setting S. S. W. 3½ miles an hour: what course must she steer to counteract the effect of the current?

Answer. The course she must steer for the Cape is N. 36° 43′ W., or N. W. ¾ N. nearly.

4. A ship sailing by her log 9 miles an hour, is bound to a port which lies N. W. b. N. from her, distant 56 miles, and finds she is in a current setting N. E. ½ N. 3 miles an hour: what course must she steer in the current, and distance make good, and how long will it take her, to arrive at her port?

Answer. The course to be steered is N. 53° 12′ W., or N. W. ¾ W.; the distance to run 53. 64 miles, and the time it will take, nearly 6 hours.

5. A ship bound from Bombay to England, being on the edge of the Bank of Agulhas on April 21st, at noon, was, by Observation, in latitude 35° 3′ S., and in longitude, by Chronometer, 26° 52′ E.; on the 22d, the latitude, by Observation at noon, was 35° 13′ S., and the longitude, by Chronometer, 25° 5′ E.; having sailed by her Reckoning N. 81° W. 39 miles: required the set and drift of the current.

Answer. The current set S. 71° 49′ W., or W. 18° 11′ S., and its drift in 24 hours was 51. 57 miles, being at the rate of 2. 15 per hour.

# DESCRIPTION AND USE OF CHARTS.

CHARTS are marine Maps, representing the whole or part of the surface of the water, and adjoining coasts; and exhibiting isles, rocks, shoals, banks, depths of water, rhumb-lines, and whatever other particulars may serve to direct the mariner on his voyage, or point out the dangers to be avoided: they are principally of two kinds, *Plane* and *Mercator's*.

## OF PLANE CHARTS.

A Plane Chart is constructed on the supposition that the surface of the earth is an extended plane, the meridians all parallel strait lines, and the parallels of latitude at equal distances, and consequently that the lengths of the degrees of latitude and longitude are every where equal. But as the earth is spherical, and the meridians meet at the Poles, it is evident that charts constructed on this principle must be erroneous; for in them the difference of longitude, or distance between two meridians at the equator, is considered as the meridian distance in all latitudes. Hence, the position of places laid down on these charts, according to their latitudes and longitudes, will vary more or less from the truth, both in bearing and distance. However, where the chart extends but a few degrees on either side of the equator, the error will be trifling; because near the equator the meridians are nearly parallel to each other; or if it begin at any considerable distance from the equator, and extend only a few degrees of latitude, the error may in a great measure be obviated, by making the length of the degree of longitude equal to the co. sine of the mean latitude, one degree, or 60 miles, being radius. These charts, from their erroneous principles, being of little or no use in the practice of Navigation, have been totally rejected since the introduction of Mercator's projection.

Plane Charts, which are constructed on the assumption that small portions of the earth's surface are planes, are called COASTING CHARTS: in these neither latitudes nor longitudes are in general taken into consideration. They are usually drawn on a large scale, for the direction of mariners when near the land; and will not deviate much from the truth, either in bearing or distance, when they do not comprehend any great extent of coast.

In these charts places are laid down according to their bearing and distance from each other. The configuration of the coast, and other particulars, are taken from the best surveys, or such information as can be most depended upon.

## OF MERCATOR'S CHARTS.

Mercator's Charts are constructed on the supposition that the earth is spherical. In these charts the meridians and parallels are strait lines, at right angles to each other; but the distances between the parallels are

increased towards the Poles, in order to compensate for the expansion of the meridian distances, by which indeed those Countries situated far from the equator become distorted, or considerably enlarged beyond their relative size, with respect to those nearer the equator; notwithstanding which, the bearings and distances of places may be easily and accurately found by these charts.

The following is the method of constructing a chart on Mercator's projection.

Having first determined the limits of the proposed chart, that is, the number of degrees and minutes it is to contain, both of latitude and longitude, and the degree of each it is to commence from, take out the meridional parts from Table III., corresponding to each degree of latitude within the intended limits, and find the difference between the meridional parts of each succeeding latitude; but if the scale of the chart be small, the meridional parts, with their differences to every fifth or tenth degree, may be taken. Reduce the difference of the meridional parts into degrees, by dividing them by 60. Draw a line near one of the margins of the paper, to represent the parallel of the least latitude, on which lay off the proposed number of degrees of longitude, taken from a scale of equal parts, and number them at every fifth or tenth degree. From each end of this parallel draw perpendicular lines for the extreme meridians, and make them equal to the difference of the meridional parts of the extreme latitudes, taken from the scale of longitude, or graduated parallel; join the ends of these meridians by a strait line, which will represent the other extreme parallel, and is to be divided in the same manner as the first parallel.

Take the meridional difference of latitude between the least latitude and the next fifth or tenth degree of latitude, from the divided parallel, and lay it off from the first parallel on each of the extreme meridians. In like manner, the meridional difference of latitude between each successive five or ten degrees is to be taken from the graduated parallel, and laid off and numbered on the meridians; but if the chart be drawn on a large scale, the meridional differences of latitude between each degree are to be laid off. The spaces are then to be subdivided into degrees or miles.

Through each fifth or tenth degree of latitude and longitude draw meridians and parallels; or through each degree, if the scale will permit, without crowding the chart with a multiplicity of lines.

The principal points in the charts are now to be laid down according to their respective latitudes and longitudes, and connected either by observations made on the coast, agreeably to the directions given for surveying coasts and harbours, or from the best charts.

One or more compasses are to be inserted in the most convenient parts of the chart, and the rhumb-lines extended to the coast. The variation of the compass is to be set down in places where it is well ascertained. Currents are to be denoted by darts. The best anchorages, soundings, times of high water, &c. are all to be marked in their proper places. For further particulars, see *Maritime Surveying*.

In order to illustrate the above Rules, let us take an Example. Suppose, for instance, it be required to draw a chart extending from 2 degrees of east

longitude to 30 degrees of west longitude, and from 10 degrees to 57 degrees of north latitude. (See Plate IV.)

Having drawn the bottom marginal line to represent the parallel of 10 degrees, divide it into 32 equal parts, the number of degrees of longitude the chart is to contain; and at each end erect a perpendicular line.

Take out the meridional parts corresponding to every fifth degree, and set them down with their differences in the following order:

| Latitudes. | Merid. Parts. | Differences. | | |
|---|---|---|---|---|
| 10° ..... | 603 | | | |
| | | ..... 307 = | 5° | 7′ |
| 15 ..... | 910 | | | |
| | | ..... 315 = | 5 | 15 |
| 20 ..... | 1225 | | | |
| | | ..... 325 = | 5 | 25 |
| 25 ..... | 1550 | | | |
| | | ..... 338 = | 5 | 38 |
| 30 ..... | 1888 | | | |
| | | ..... 356 = | 5 | 56 |
| 35 ..... | 2244 | | | |
| | | ..... 379 = | 6 | 19 |
| 40 ..... | 2623 | | | |
| | | ..... 407 = | 6 | 47 |
| 45 ..... | 3030 | | | |
| | | ..... 444 = | 7 | 24 |
| 50 ..... | 3474 | | | |
| | | ..... 494 = | 8 | 14 |
| 55 ..... | 3968 | | | |
| | | ..... 215 = | 3 | 35 |
| 57 ..... | 4183 | | | |

Now take the first difference 5° 7′ in the compasses from the divided parallel, and lay it off on both meridians from 10° to 15°; from 15° to 20° lay off the next difference 5° 15′, taken from the same parallel, and so proceed to the latitude 57°; through each of these corresponding points draw lines, to represent the respective parallels of latitude, and subdivide the extreme meridians into degrees. Divide the parallel of 57° in the same manner as that of 10°, and draw meridian lines through every fifth degree, numbering them as on the chart.

The principal points are to be laid down agreeably to their latitudes and longitudes, through which the coast is to be drawn; and the various particulars are to be inserted, as rocks, shoals, islands, a compass, &c. which will be best understood by inspecting the chart.

## USE OF MERCATOR'S CHART.

### *To find the Latitude and Longitude of a Place on the Chart.*

With a pair of compasses take the least distance between the given place, and the nearest parallel of latitude; apply that distance, the same way, on one of the graduated meridians, one foot of the compasses being fixed at that point where the parallel cuts the graduated meridian, and the other will shew the latitude of the place.

The least distance between the given place and one of the nearest meridians being applied in the same manner to either of the graduated parallels, will point out the longitude of the place.

For example. The least distance between Cape St. Vincent and the parallel of 35° on the chart, being taken and applied to one of the graduated meridians from the same parallel upwards, will give its latitude about

30 25 20 15 10 5 West Long. 0 East
NORTH SEA
Edinburgh
SCOTLAND
IRELAND
Donegal B.
Galway Bay
Dublin
Shannon Bay
Cork
Cape Clear
St George's Chan.
Bristol Chan.
Whitby
Liverpool
Yarmouth
ENGLAND
London
Greenwich
Bristol
Start
British Channel
Var. 28° 20. W.
Scilly Is.
Lizard
Guernsey
Brest
St Malo
FRANCE
Nantes
Rochfort
Bayonne
Ushant
Devils Rock
Mayda I.
Green I.
BAY OF BISCAY
Bordeaux
C. Ortegal
C. Finisterre
Ferrol
St Vincent
Bilboa
Vigo
Oporto
PORTUGAL
SPAIN
Barcelona
Valencia
Carthagena
Lisbon
Palos
Gibraltar
C. St Vincent
Cadiz
Alboran
MEDITERRANEAN
WESTERN ISLANDS
Fayal
Graciosa
Terceira
St Michael
St Mary
ATLANTIC
8 Stones
MADEIRAS
Porto Santo
Madeira
Desertas
Salvages
Joanna
Steen
OCEAN
Tangier
Zanarina
Salee
BARBARY
Azamor
C. Cantin
Morocco
Sta Cruz
CANARIES
Lanzarote
Teneriffe
Palma
Ferro
Fuerteventura
Aguiah
C. Nun
Arabs
AFRICA
B
C. Bojador
Seven Capes
Cintra Bay
Var. 9° 47. W.
St Cyprians Bay
C. Blanco
Arguin Bay
C. Myrick
CAPE VERD ISLES
St Antonio
Sal
St Nicholas
Bonavista
St Iago
Brava
Fogo
R. Senegal
St Louis
C. Verd
R. Gambia
C. Rouxo
Tenba
R. Grande
Bissagos
A Chart FROM England TO THE CAPE VERD ISLANDS ON MERCATORS PROJECTION
30 25 20 15 10 5 West Long. 0 East
Neele delin.
J. Dow

37 degrees N.; and the least distance between the same Cape and the meridian of 10°, being applied to either graduated parallel, towards the right from that meridian, will give its longitude 9° West.

### *To lay down upon the Chart any Place whose Latitude and Longitude are given.*

Lay the edge of a scale over the parallel of the given latitude, and with a pair of compasses take, from one of the divided parallels, the distance between the given longitude and the nearest meridian line: this being applied along the edge of the scale, from that point where the scale intersects the meridian line, the same way that the longitude lies, will point out the place required.

Example. Suppose a ship be in latitude 52°30′ N., and longitude 23° W.: required its situation on the chart.

Lay the edge of the scale over latitude 52° 30′ N., and take from one of the divided parallels the distance between the meridian of 20°, and the longitude 23°; this being laid off along the edge of the scale, towards the left, from the meridian of 20°, will give the ship's place at A.

In this manner a ship's track is usually pricked off at sea, her latitude and longitude being laid down every day at noon; and the ship's places connected by pencil-lines drawn between them.

### *To find the Course or Bearing between two Places on the Chart.*

Lay the edge of a scale over the given places, and take the least distance between the centre of one of the compasses drawn on the chart, and the edge of the scale; move this extent along, so that one point of the compass may touch the edge of the scale, while the other is to be kept in a perpendicular position to it, with respect to the edge of the scale; then that other point will generate an imaginary line, passing through the centre of the compass on the chart, which will shew the course or bearing.

Or, with a parallel rule, lay one of its edges over both the places; then move the two parts of the rule in succession, until the edge of one of them pass through the centre of a compass on the chart; and that edge will point out the course.

### *To find the Distance between any two Places on the Chart.*

1. If the given places lay under the same meridian, find their latitudes on the chart; and the difference or sum of these, according as the places lay on the same, or on different sides of the equator, will give the distance.

2. If the given places lay in the same parallel of latitude, take half the distance between them, and placing one foot of the compasses in the graduated meridian on their latitude, observe what latitudes the other foot points to, both above and below: the difference between these will be their distance.

3. But if the given places differ both in latitude and longitude, take the distance between them, and apply it to either of the graduated meridians, so that one foot of the compasses may be as much above one place as the other is below the other place; then the degrees or minutes contained between the points of the compasses, will be the distance required, which may be reduced to miles or leagues.

But if the places lay nearly in a parallel, and their distance be considerable, it will conduce to accuracy if the middle latitude between the two places be found; then half their distance being applied alternately above and below the middle latitude, will give the distance:

Or, a degree may be taken near the middle parallel, and the number of these degrees and parts contained between the two places being measured along the edge of the scale, will give the distance.

The distance may also be found in the following manner:—Find the difference of latitude between the given places, and take it from the equator, or one of the graduated parallels; then lay the edge of a scale over the given places, and move or slide one point of the compasses along the edge of the scale (keeping both points parallel to the meridians), until the other point just touch a parallel. Now, the distance between the place where the point of the compasses rested, and the point of intersection of the edge of the scale and parallel, being applied to the equator, or one of the graduated parallels, will give the distance in degrees and parts, which may be reduced to miles.

Example. Required the course and distance from Cape St. Vincent to the east end of the Island of Madeira.

Lay the edge of a scale over the two places, and take the least distance between it and the centre of the compass; then sliding one point along the edge of the scale, the other will shew the course to be S. W. b. W. nearly: the extent between the two places being taken with the compasses, and applied to one of the graduated meridians, will reach from 31° to about 38° 40′, being an interval of 7° 40′: hence the distance is 460 miles.

Or, take the difference of latitude between the two places, which is 4° 19′, from either of the graduated parallels, and laying the edge of the scale over the two places, move one point of the compasses along it until the other just touch a parallel, as that of 35°; then the extent between the place where the foot of the compasses rested, and the point where the scale cuts the parallel of 35°, being applied to the graduated parallel, will give the distance 7° 40′, or 460 miles, as before.

### *The Course steered, and Distance run from any given Place, being known, to find the Ship's Place on the Chart.*

Lay the edge of the scale over the given place in the direction of the ship's course; then take the distance run from that part of one of the graduated meridians opposite the given place and the supposed place of the ship, which lay off from the given place along the edge of the scale, and it will shew the place of the ship. Or, placing the scale as before directed, take the given distance from one of the graduated parallels; put one foot

of the compasses in that point of a parallel that is cut by the edge of the scale, and the other foot will reach to a certain place along the edge of the scale. Now this foot remaining in the same position, draw in the other point of the compasses until it just touch the above parallel, without crossing it; apply this extent to the graduated parallel, and it will give the difference of latitude: hence the latitude in will be known, through which a parallel being drawn, that point where it intersects the edge of the scale, will be the ship's place.

Example. Suppose a ship sail N. W. b. N. 400 miles from Cape Blanco: required her place on the Chart.

By either of the above methods the ship's place will be found at B, in latitude 26° 23 N., and in longitude 21° 10′ W.

# MARINE SURVEYING.

NOTWITHSTANDING the great importance of accurate surveys of the various coasts and harbours that are frequented by mariners, it must be confessed that the manner of executing this branch of the nautical Art has been but little attended to, and that the opportunities which so frequently occur to seamen of adding to our present stock of geographical knowledge, are almost entirely neglected, or at least such incorrect observations made, as can be of little service to the attainment of truth. We therefore think it proper, before we proceed to the astronomical part of the Work, to lay down a few general directions, illustrated by proper examples, shewing how a coast or harbour may be easily surveyed with such instruments as are commonly used at sea; and we shall at the same time explain the method of delineating the observations on paper.*

## *To survey a Bay or Harbour.*

Take a general view of the place, by walking or sailing round it. During this time make a rough sketch of the coast, carefully drawing the various projections and bendings, and noting whatever is remarkable. On the principal points and curves place station-staves, or strait poles, high enough to be seen at a considerable distance; and, to render these more conspicuous, fasten a piece of white bunting to the top of them: if there be a tree, house, or other remarkable object at any of these places, it may serve instead of a station-staff; these are all to be marked down on the eye-sketch, either with letters or numbers, in order to distinguish them.

* Those who are desirous of obtaining further information on this subject, may consult the following Works:—"A Treatise on Marine Surveying, by Murdoch Mackenzie, Sen., corrected and republished, with a Supplement, by James Horsburgh, F. R. S., &c." and "An Introduction to the Practice of Nautical Surveying, and the Construction of Sea Charts; translated from the French of C. F. Beautemps-Beaupre, by Captain R. Copeland, R. N."

Proceed now to determine the position of the stations by observations made either on shore or on the water. In the former case, find a level spot of ground near the shore whereon a base-line may be measured, which base-line must be so situated, that the whole, or the most part, of the stations, or remarkable objects, may be seen from both the extremities; and its length and direction, if possible, such, that the angle contained between it and any of the station-staves taken from one end, may differ at least ten degrees from the same taken from the other end thereof. Then set up two station-staves; the further these are from each other, in general, the better; carefully measure their distance either by a chain, a measuring pole, or a piece of log-line divided into feet, and observe their bearing as accurately as possible by an azimuth compass.

If a base-line of sufficient length cannot be taken in one right line, two adjoining lines and their included angle may be measured, and the distance between their extremes found either by construction or computation, which may be considered as a base: the bearing of this line may be ascertained from that of one of the measured lines and the adjacent angle.

When the survey cannot be taken on shore, (which, however, is always to be preferred, on account of the superior accuracy with which the observations can be made), a base-line may be laid down on the water, by mooring two buoys in the most convenient situations, and measuring, as accurately as possible, their bearing and distance from each other.

Having fixed upon a base-line, from each extremity, observe the bearing of the several remarked objects, and note them down in their proper order; or rather, with a quadrant or sextant, observe the angles formed between the base-line and lines drawn from each end to the several stations. If any of the angles exceed the limits of the instrument, it may be measured at twice, by taking the angular distance of some intermediate object from each extreme object. These bearings or angles are all to be entered on paper, as they are taken, and distinguished by the letters marked on the rough sketch.

If any of the objects be not visible from both or either end of the base-line, their positions must be ascertained by angles taken from stations whose situations are already known. Sometimes it will be necessary to measure out a new base, which is to be connected, if possible, with the first base, either by angles taken from both extremities of the first base, or from one extremity and a station-staff, or from two station-staves whose positions have been previously determined.

When the survey is made by base-lines on the water, if all the principal points cannot be seen from two stations, moor as many buoys as are necessary, and observe their bearings and distances from each other, which set down in the manner of a Traverse; bearings or angles being then taken from any two of them whose situations have been determined, will give the positions of the places required.

Having proceeded so far on the survey, it will be proper to lay down the observations on paper; for which purpose describe a circle with the chord of 60°, and through its centre draw the magnetic north and south line: on this circle lay off the bearing of the base, and draw a line parallel to it on

a convenient part of the paper, to represent the position and length of the base. From each end of the base draw lines parallel to the respective observed bearings, previously laid down on the circle; or if angles between the base-line and the stations be observed, a circle is to be drawn at each end of the base on which they are to be laid off; then the intersection of each pair of corresponding lines will give the position of the stations, between each of which the configuration of the coast is to be drawn from the sketches already made.

Now sail about the harbour at low water, and take the soundings or depths of the sea, observing whether the ground be rocky, sandy, shelly, &c. At the place where each sounding is taken, observe the bearings of two remarkable objects, whose positions had been previously determined: hence its situation may be laid down on the chart, where the depth of water is to be denoted by small numeral figures. In like manner determine the situation of rocks, shoals, anchoring-places, &c. that may be in or near the harbour, and mark them down accordingly*. Observe the set and velocity of the tide of flood, by heaving the log while at anchor, and denote the same on the chart by small darts. The time of high water, at new and full moon, is to be inserted in Roman numeral letters; rocks are to be denoted by small crosses; sands by dotted shading; good anchoring-places by a small anchor, and stopping places by a small anchor without a stock. Whilst going on with the necessary operations on the water, take particular care, on coming near the shore, to correct the outline of the chart, by observing the inflection, creeks, &c. more minutely.

In a small sailing vessel go out to sea, and take drawings of the appearance of the land, with its bearings. Sail into the harbour, observe the appearance of its entrance, and particularly whether there be any false resemblance of an entrance, by which ships may be deceived into danger. Remark the signs or objects, by attending to which, the harbour may be entered with safety; more especially, where it can be done, let the ship steer to the anchoring-place, keeping two remarkable objects in one, or in a line. These leading marks are to be inserted on the draught, by drawing fine double lines through the objects.

The necessary observations being all laid down on the chart, shade the coast on the land-side with Indian ink, and draw houses, churches, trees, &c. in their proper places; the coast should be shaded so as to exhibit, as nearly as possible, its natural appearance, particularly shewing whether it be high, low, sandy, rocky, bad shore, &c. In a convenient place insert a Mariner's Compass, by which the situation of the rhumbs will be shewn: this may be drawn either according to the magnetic or true north, as may be thought proper; the variation is to be marked by placing a small fleur de lis at the north point from which the compass is not drawn. The name of the place, on what coast or country, the latitude and longitude, and whatever else may be thought necessary, are to be ascertained and inserted in the chart.

* When the relative positions of three stations are well determined, a fourth station may be found, as shewn in Example V. of Oblique Sailing: in this manner the situation of rocks, shoals, soundings, &c. may be accurately laid down.

### *To survey a Coast while sailing along it.*

When the ship has arrived at a convenient situation, from whence there is a tolerably extensive view of the coast, there cast anchor, or lay-to as steady as possible; then, while the vessel is in this stationary position, observe, with an azimuth compass, the bearings of the most material projections and hollows, and whatever objects are remarkable on the coast; or rather, take the bearing of one of the most conspicuous points, and observe, with a quadrant or sextant, the angular distances contained between it and the other remarkable objects; write these down on paper, and make a rough sketch of the coast, on which mark the observed points, &c. with letters, for the sake of reference.

Then let the ship run in a direct line upon a known course, measuring the distance with all imaginable care by a log, or otherwise; during which time take soundings, and draw a more correct sketch of the coast, with appearances of land, &c. When she has at length attained a proper situation, from whence the same points and objects before observed may be still seen, lay-to, as at the first station, and again observe the bearings or angles of the former objects, and likewise of others in the continuation of the coast, which note down as before: in this manner proceed from station to station, until the survey be extended as far as may be thought proper.

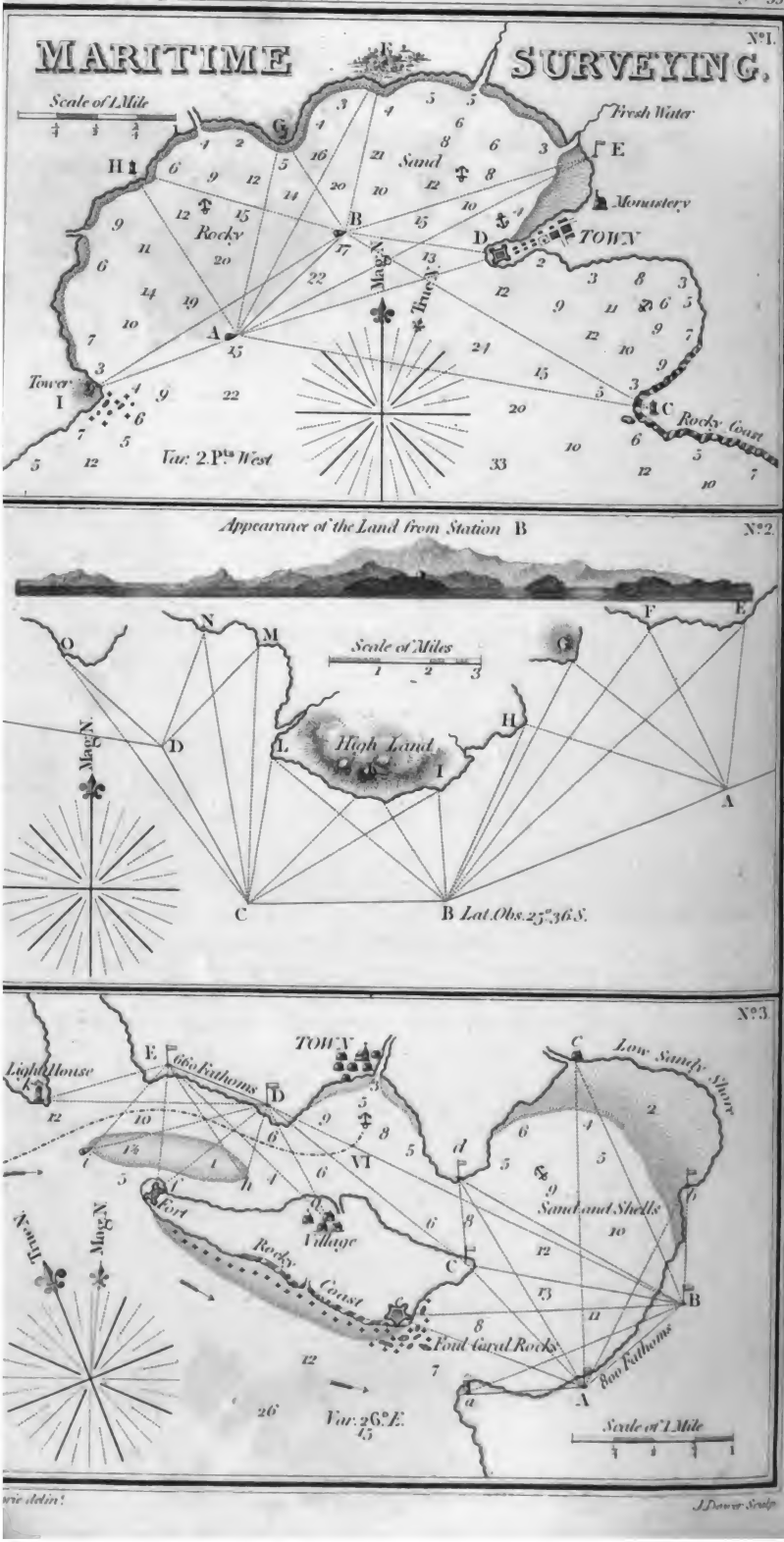
The observations are to be laid down on paper, by drawing the ship's courses and distances between the stations, in the manner of a Traverse, and setting off the bearings and angles observed at each station; then the intersection of the corresponding lines will give the position of the several observed points and objects, through which the configuration of the coast is to be drawn from the sketches made while sailing along it.

### *To reduce a Draught to any Scale required.*

Surveys being usually drawn upon a large scale, for the sake of accuracy, it frequently becomes necessary to reduce them to a smaller, when they are used in the construction of charts, in order to adapt them to that particular scale on which the other parts of the chart are drawn: this may be performed several ways; but the following is the easiest, and the most convenient in practice.

Divide the whole, or that part of the draught to be copied, into small squares, by setting off any convenient number of equal divisions on the marginal lines, and through these drawing lines across the draught with a black-lead pencil; in like manner divide that part of the paper on which the copy is to be taken, into the same number of squares. If the divisions round the margins be numbered alike on both draughts, or if every fourth or fifth line be drawn somewhat stronger than the rest, the corresponding squares will be more readily discovered. With a pencil draw in such lines, curves, and other particulars on the copy as are found in the corresponding squares of the former draught: when the whole is thus correctly copied, draw the lines, &c. over with a pen dipped in Indian ink dissolved in water, and when dry, rub out the pencil-lines with Indian rubber, or crumbs of stale bread.

We shall now proceed to elucidate what has been said on Surveying, by the three following Examples, each of which exhibits a different method of conducting the operation.


MARITIME SURVEYING.
Nº1.
Scale of 1 Mile
Fresh Water
Sand
Monastery
TOWN
Rocky
Mag.N
True N
Tower
Rocky Coast
Var: 2 Pts West
Appearance of the Land from Station B
Nº2.
Scale of Miles
High Land
Mag.N
B Lat.Obs.25°.36.S.
Nº3.
TOWN
Low Sandy Shore
Light House
660 Fathoms
Sand and Shells
Fort
Village
Rocky Coast
Mag.N
True N
Foul Coral Rocks
800 Fathoms
Var: 26°.E.
Scale of 1 Mile

## EXAMPLE I.

Let it be required to survey the harbour (No. 1, Plate V.) by observations made on the water.

Having sailed round the harbour, and fixed upon the several stations on the coast, let the two buoys, A and B, be moored so that all the points or stations may be seen from both, whose bearing, from A to B, as observed by an azimuth compass, suppose to be N. 46° E., and their distance measured by a log, one mile*; then having taken the boat to the stations A and B, suppose the following bearings to have been taken.

| From Station A. | | From Station B. | |
|---|---|---|---|
| AC = N. 100° E. | | BC = N. 121° E. | |
| AD = N. 72 E. | | BD = N. 99 E. | |
| AE = N. 63 E. | | BE = N. 73 E. | |
| AF = N. 29 E. | | BF = N. 12 E. | |
| AG = N. 12 E. | | BG = N. 36 W. | |
| AH = N. 33 W. | | BH = N. 74 W. | |
| AI = N. 110 W. | | BI = N. 122 W. | |

The above bearings being observed, proceed to draw the plan as follows: In a convenient part of the paper describe a circle, with the chord of 60°, and through the centre draw a line, to represent the magnetic meridian, or north and south line; on this circle lay off the bearings, as above, and through A and B draw lines parallel to them; then the intersection of these lines will give the position of the points CDEFGHI, through which draw the configuration of the coast, according to the sketch previously made, and insert the isles, rocks, shoals, and sand-banks, that lay within or near the harbour, with the marks to avoid them, the proper places for anchoring, the depth of water in various parts, the variation of the compass, and whatever other particulars may appear worthy of notice.

## EXAMPLE II.

Wanting to survey a coast whilst sailing along it, I ran from A to B (No. 2, Plate V.) W. S. W. 6 miles; from B to C, West 4 miles; and from C to D, N. N. W. ½ W. 3½ miles; taking the following bearings and angles at each station:

| 1. From Station A. | | | | 2. From Station B. | | | |
|---|---|---|---|---|---|---|---|
| The Bearing of AG = N. | 51° | 0′ W. | | The Bearing of BK = N. | 33° | 0′ W. | |
| The Angle GAE = | 58 | 40 | | The Angle KBL = | 17 | 40 | |
| —— GAF = | 25 | 0 | | —— KBI = | 28 | 35 | |
| —— GAH = | 21 | 50 | | —— KBH = | 56 | 0 | |
| | | | | —— KBG = | 60 | 0 | |
| | | | | —— KBF = | 69 | 40 | |
| | | | | —— KBE = | 80 | 3 | |

* In a case like this, where it is necessary to make the observations on the water, as it will be difficult to measure accurately the distance between the buoys, the same may be ascertained between any two of the stations on shore, which will furnish a scale for the plan; and the bearings or angles being taken from the buoys, will shew the relative position of the stations.

| 3. From Station C. | | | | 4. From Station D. | | | |
|---|---|---|---|---|---|---|---|
| The Bearing of CK | = N. | 46° | 0′ E. | The Bearing of DN | = N. | 20° | 0′ E. |
| The Angle KCI | = | 13 | 16 | The Angle NDO | = | 67 | 50 |
| —— KCL | = | 36 | 30 | —— NDM | = | 22 | 5 |
| —— KCM | = | 44 | 0 | | | | |
| —— KCN | = | 55 | 45 | | | | |
| —— KCO | = | 83 | 26 | | | | |

To delineate these observations on paper, first draw a compass in a convenient part, and fix upon a point, as A, for the first station; through which draw the line AB parallel to the W. S. W. rhumb-line, and equal to 6 miles, the distance run on that rhumb; then will B be the second station: proceed in like manner with the second and third courses, by which you will obtain the third and fourth stations, C and D. Through A draw the line AG parallel to N. 51° W., laid off on the compass, and make the angles GAE, GAF, GAH, according to the above observations: in the same manner the bearings and angles are to be laid down from the other stations; then the intersecting lines will give the points EFG, &c., through which the coast is to be drawn, agreeably to the sketches made at the time of passing along it. The scale of miles is to be laid down from the same equal parts as the distances run were measured by.

## EXAMPLE III.

Let it be required to take an accurate survey, and from thence to make a chart of the harbour and adjacent island, (No. 3, Plate V.)

Sail round the coasts to be surveyed, and fix station-staves on the principal points, where there are no remarkable objects to distinguish them: at the same time take a rough sketch of the harbour, on which denote the situation of the objects and stations by the letters *a*, *b*, *c*, &c.; it will likewise be advisable to take a more particular sketch of the coasts between each station, on a separate piece of paper. Seek for a proper place near the shore, on which a base-line may be measured; and, since there is no part of the coast which commands a view of all the stations, it will be necessary to measure out two base-lines: accordingly the base-line AB is fixed upon, the ground being there level, and a considerable number of station-staves visible from each extremity: its length, as measured by a chain, is 800 fathoms, and its bearing from A to B, N. 48° E. From each end measure the angles contained between the base-line and the several stations within sight, which are as follow:

| From Station A. | | | | From Station B. | | | |
|---|---|---|---|---|---|---|---|
| The Angle BA *b* | = | 23° | 35′ | The Angle AB *a* | = | 18° | 40′ |
| —— BA *c* | = | 52 | 10 | —— AB *e* | = | 38 | 0 |
| —— BA *d* | = | 82 | 0 | —— ABC | = | 50 | 15 |
| —— BAC | = | 94 | 0 | —— ABD | = | 66 | 0 |
| —— CA *e* | = | 25 | 13 | —— AB *d* | = | 69 | 36 |
| —— CA *a* | = | 47 | 30 | —— *d* B *c* | = | 36 | 25 |
| | | | | —— *d* B *b* | = | 61 | 10 |

It will now be necessary to fix upon a place whereon another base-line may be measured, from whence the remaining stations may be seen. The most convenient spot is between D and E; let D E, therefore, be the second base-line, its length being 660 fathoms, and bearing from D to E, N. 72° W.; but as its southern extremity D can be seen only from one end of the first base, the angle *d* C D is to be observed from C, in order to ascertain the position of the second base with regard to the first; this angle is found to be 44° 0′; now measure the angles formed by lines drawn from each end of this base to the station-staves, or other objects, which are as follow:

| From Station D. | | | From Station E. | | |
|---|---|---|---|---|---|
| The Angle E D *k* | = | 21° 15′ | The Angle D E *g* | = | 22° 28′ |
| —— E D *f* | = | 59 42 | —— D E *f* | = | 74 0 |
| —— *f* D *g* | = | 79 25 | —— *f* E *k* | = | 70 0 |

Having taken all the necessary bearings and angles on shore, lay them down upon paper agreeably to the preceding directions: hence the relative position of the points *a*, A, B, *b*, *c*, *d*, D, E, C, *e*, *f*, *g*, and *k*, will be obtained; which are to be connected by drawing the configuration of the coast from the sketches made whilst sailing round the harbour and island. The chart being thus far delineated, proceed to make the requisite observations on the water. In sounding for the depths of water, a shoal is discovered in one of the entrances: now its extremes *i h* are to be ascertained by their bearings from the stations D and E; the bearing of *i* E is N. 40° E., and of *i* D, N. 72° E.; also the bearing of *h* E is N. 40° W., and of *h* D N. 10° E.: to lay these down on the chart, through E and D draw lines parallel to the above bearings, which are to be previously laid off on the compass; these will meet at *i* and *h*, and determine the extremities of the shoal.* In the same way the positions of the soundings, anchoring places, rocks, &c. are to be ascertained and laid down.

The above bearings being all magnetic, and it being thought proper to draw a compass according to the true meridian, the variation, which is 26° easterly, is to be laid off to the left of the magnetic north; hence the direction of the true meridian and the other rhumb-lines will be obtained.

The scale shews the length of a geographical mile, containing 1013 fathoms; therefore take 1013 from the same scale of equal parts that was used in laying down the base-lines; or, make the transverse distance of 400 on the sector, equal to the length of the base A B; then the transverse distance of 506 will be the length of one mile. (See Use of Sector, page 32.)

The following methods of ascertaining the heights and distances of remote objects being frequently useful, particularly in the practice of surveying, we think it proper to introduce them before we dismiss the present subject.

### *To find the Height of an accessible Object.*

Measure the horizontal distance, between the eye and the object, of the point immediately under it, and observe the angle of elevation with a

* Or, more accurately, by taking the angles subtended by the Stations D, E, *k*, at *i* and *h*, the extremities of the shoal, as shewn in Example V. of Oblique Sailing.

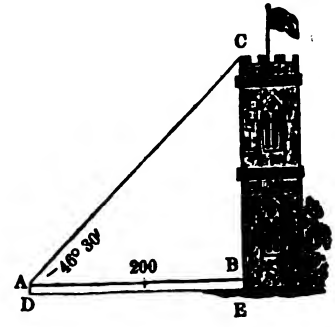
quadrant: thus will be obtained the base and angles of a right-angled triangle, the perpendicular of which being found, will be the height of the object above the horizontal plane, to which add the height of the eye.

Or, by removing either towards or from the object, until the angle of elevation be 45°, the horizontal distance, added to the height of the eye, will give the height of the object.

## EXAMPLE.

From the bottom of a tower I measured 200 feet on a horizontal plane; I then took the angle of elevation, and found it 46° 30′, the height of my eye being 6 feet: required the height of the tower.

In the triangle A B C are given the side A B 200 feet, and the angle B A C 46° 30′, to find the perpendicular B C.




| | | |
|---|---|---|
| As radius ..... | | 10. 00000 |
| Is to the distance A B or D E 200... | | 2. 30103 |
| So is tang. angle B A C 46° 30′..... | | 10. 02275 |
| To the perpendicular B C | 210. 7 | 2. 32378 |
| Height of the eye A D or B E | 6 | |
| Height of the tower C E ... | 216. 7 feet | |

If the height of the object be known, and the angle of elevation observed, the horizontal distance of the eye may be found; for in this case there will be given the perpendicular and angles of a right-angled triangle to find the base or distance required.

### *To find the Height of an inaccessible Object.*

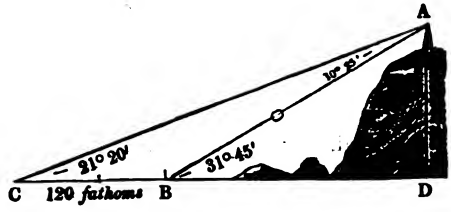
Measure the angle of elevation at a convenient distance from the given object; then remove in a direct line from the object, and again observe the angle of elevation, the distance between the stations being carefully measured: hence will be given one side and the angles of an oblique-angled triangle, with which, find the less of the other sides. Now that side will be the hypothenuse of a right-angled triangle, the perpendicular of which

being found, and the height of the eye added to it, their sum will be the height of the object.

## EXAMPLE.

Wanting to know the height of a lighthouse above the level of the sea, and not being able to measure its horizontal distance, I took the angle of elevation, and found it to be 31° 45′, and after removing from it 120 fathoms, I observed the angle of elevation to be 21° 20′: required the height of the lighthouse.

In the triangle A B C are given the angle A C B 21° 20′; the angle C A B 10° 25′; and the side C B 120 fathoms, to find the side B A.




| | | |
|---|---|---|
| Angle A C B..... | 21° | 20′ |
| Angle A B C.....148 | | 15 |
| | 169 | 35 |
| | 180 | 0 |
| Angle C A B..... | 10 | 25 |

| | |
|---|---|
| As sine angle C A B 10° 25′ ..... | 9. 25721 |
| Is to the side C B 120 ..... | 2. 07918 |
| So is sine angle A C B 21° 20′ ..... | 9. 56085 |
| | 11. 64003 |
| | 9. 25721 |
| To the side A B 241. 4 ..... | 2. 38282 |

In the right-angled triangle A B D are given the angle A B D 31° 45′, and the hypothenuse A B 241. 4, to find the perpendicular A D.

| | |
|---|---|
| As radius ..... | 10: 00000 |
| Is to the hypothenuse A B 241. 4... | 2. 38274 |
| So is sine of angle A B D 31° 45′... | 9. 72116 |
| To the perpendicular A D 127..... | 2. 10390 |

Hence the height of the lighthouse is 127 fathoms, or 762 feet above the level of the sea.

In this example the height of the eye is neglected; for, supposing the observations to have been made in a boat, the eye would nearly coincide with the surface of the water, and hence the omission would lead to no material error.

Shorter methods might have been given for solving the above; but as the present is worked directly by the Rules of Trigonometry, it is more likely to be retained in the memory.

### *To find the Distance of Objects at Sea by Means of the Curvature of the Earth.*

To the logarithm of the diameter of the earth, increased by the height of the eye, add the logarithm of that height, and half the sum will be the logarithm of the distance of the visible horizon in feet; from which subtract the constant logarithm 3. 783904, and the remainder will be the distance in nautical miles, to which add a twelfth part of the distance, on account of terrestrial refraction.

#### EXAMPLE.

At what distance is the visible horizon from a person, whose eye is elevated 120 feet above the surface of the water?

| | | | |
|---|---|---|---|
| Diameter of the earth in feet..... | 41804400 | | |
| Height of the eye ..... | 120 | Log. | 2. 079181 |
| | 41804520 | Log. | 7. 621223 |
| | | | 9. 700404 |
| Distance in feet ..... | 70827. 5 | Log. | 4. 850202 |
| | Constant | Log. | 3. 783904 |
| Distance in nautical miles ..... | 11. 65 | Log. | 1. 066298 |
| Add one-twelfth part..... | 0. 97 | | |
| Distance corrected for refraction.. | 12. 62 | | |

When the height of a distant object appearing in the horizon is given, its distance from the eye is found by adding together the distances answering to each height. (See Explanation to Table XX.)

### *To find the Distance of an Object, by observing the Interval between the Flash and Report of a Gun.*

Multiply 1142 (the number of feet sound travels in a second) by the number of seconds in the above interval; and the product will be the distance in feet, which, divided by 6079, will give the distance in nautical miles.

#### EXAMPLE.

A ship at sea was observed to fire a gun, and 24 seconds afterwards the report was heard: required the distance of the ship from the observer.

1142 multiplied by 24 gives 27408, the distance in feet, which, divided by 6079, gives 4½ miles.

# ASTRONOMY.

## SOLAR SYSTEM.

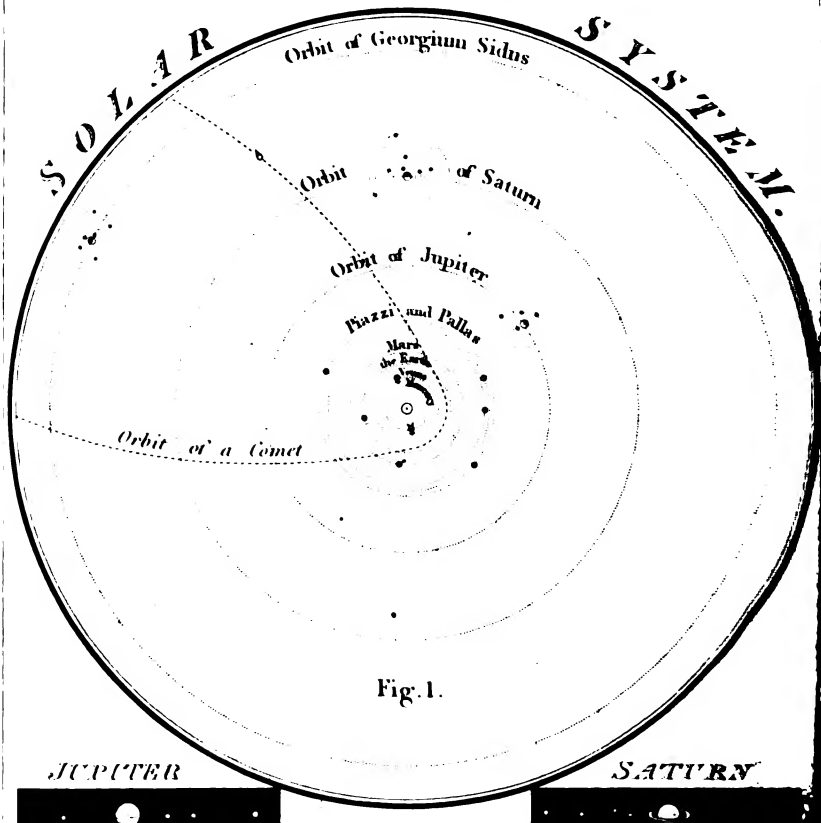



Fig. 1.

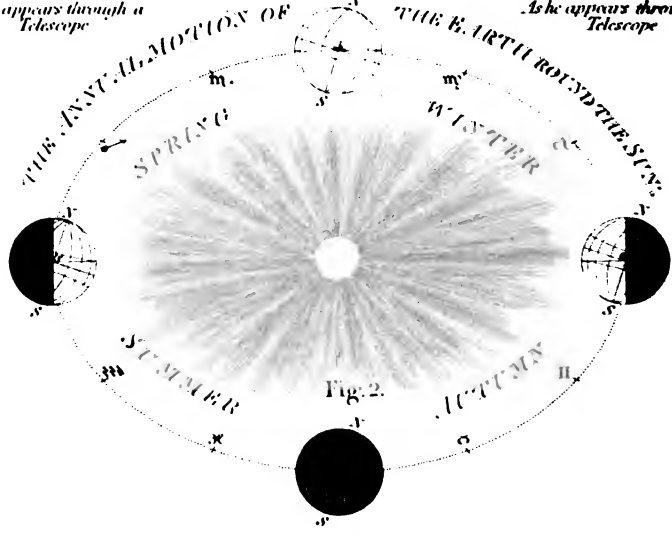



Fig. 2.

# ASTRONOMY.

ASTRONOMY is a science which treats of the motions and distances of the heavenly bodies, and of the appearances thence arising.

A great variety of opinions prevailed, at different times, among philosophers of former ages, concerning the order and arrangement of the several parts of the universe, or of the positions of those bodies which appear in the heavens. The most eminent Astronomers of the present day suppose the universe composed of an infinite number of systems or worlds; that in every system there are certain bodies moving in free space, and revolving at different distances around a sun, placed in or near the centre of the system, and that these suns and other bodies are the *stars* which are seen in the heavens.

The STARS are distinguished into two kinds, *viz. fixed* and *wandering*. The fixed stars are supposed to be suns in the centre of their systems, shining with their own light, and preserving always the same situations with respect to each other: they are usually divided, according to their apparent splendour, into different classes, called *magnitudes*; the brightest being denominated stars of the first magnitude; the next to them in brightness, of the second magnitude; and so on to those stars that are scarcely visible to the naked eye, which are termed stars of the sixth or seventh magnitude.

In order to assist the memory, Astronomers have divided the heavens into parcels, called *constellations*: these are a number of fixed stars, lying contiguous, which are supposed to be circumscribed by the outline of some animal, or other imaginary figure. Stars which are not included within the constellations, are called *unformed stars*. The stars in each constellation are generally distinguished by letters of the Greek alphabet, and some of the principal have proper names: thus the star marked $\alpha$, in the constellation of Taurus, is called *Aldebaran*.

The wandering stars are those bodies within our system which revolve round the sun; they appear luminous, by reflecting the light they receive from the sun, and are of three kinds, namely, *primary planets*, *secondary planets*, and *comets*.

PRIMARY PLANETS are those bodies which, in revolving round the sun, respect him only as the centre of their revolution; their motions are regularly performed in tracks or paths, called ORBITS, which are nearly circular and concentric with each other.

A SECONDARY PLANET, called also a SATELLITE or MOON, is a body which, while it is carried round the sun, also revolves round a primary planet, which it respects as its centre.

COMETS are a kind of planets which move round the sun in very eccentric orbits, and in various directions, having vast atmospheres about them, and tails of a hairy or nebulous appearance, especially when they are near the sun.

## OF THE SOLAR SYSTEM.

The SOLAR SYSTEM is that in which our earth is placed, and in which the sun is supposed to be fixed near the centre, with several bodies similar to our earth revolving round him at different distances. This hypothesis, which is the only one that can explain all the phenomena of the heavenly bodies, is said to have been first taught by Pythagoras; after whose time it remained many ages in oblivion, until it was revived, in the beginning of the sixteenth century, by Copernicus, and has since been fully established on the firm basis of demonstration by the immortal Newton.

There are eleven primary planets in our system, accompanied by at least sixteen satellites. The names of the primary planets, with their characters, reckoned in order from the Sun ☉, are as follow:—Mercury ☿, Venus ♀, Earth ⊕, Mars ♂, Vesta ⚹, Juno ⚵, Ceres ⚳, Pallas ⚴, Jupiter ♃, Saturn ♄, and Uranus, Herschel, or Georgium Sidus ♅ (See Plate VI. Fig. I.)

Mercury and Venus are called *inferior planets*, because their orbits are within the Earth's; the others are called *superior planets*, as their orbits include that of the Earth.

The primary planets, accompanied by their satellites, revolve round the sun from west to east, in various portions of time, which are called their *periodic revolution*, or *annual motion*; the planes of their orbits all pass through the centre of the sun, but are inclined more or less to that of the earth, crossing it in two points, called *Nodes*.

Although to an observer placed in the sun, the planets would appear to move in due order about him, from west to east, yet, since the earth is not in the centre of the system, their apparent motions in the heavens are very irregular: sometimes they appear to move from west to east, and then to stand still; then they seem to move from east to west, and after standing some time, they again move from west to east, and so on continually. The motion of a planet from west to east is called the *direct* motion, or according to the order of the signs. The contrary motion from east to west is called *retrograde*; and when the planet appears to stand still, it is said to be *stationary*.

The situation of a planet in the heavens, as it would appear if seen from the sun, is called its *heliocentric place*; and as seen from the earth, its *geocentric place*.

The angular distance of a planet from the sun is termed its *elongation*.

When a planet is in the same part of the heavens with the sun, those bodies are said to be in *conjunction*; and when their angular distance is 180°, in *opposition*. The same terms are used with respect to any other two celestial bodies.

We now proceed to give a more particular description of the sun and the planets.

The SUN, that great fountain of heat, light, and vegetation, is an immense spherical body, placed near the centre of the orbits of all the planets; its diameter is about 882,000 English miles, and it turns round its axis in 25 days 10 hours.

MERCURY is, of all the primary planets, the nearest to the sun: his diameter is about 3140 miles, and mean distance from that luminary above 36 millions of miles. His periodic revolution is performed in 87 days 23 hours.

To a spectator on the earth this planet keeps so near the sun, that we can seldom discern him without the aid of telescopes: he appears sometimes a little before sunset, and at other times a little after sunrise.

VENUS is the next planet in the order of the system, and is distinguished by her superior brilliancy; her diameter is 7687 miles, her mean distance from the sun nearly 68 millions of miles, and her periodic revolution is performed in 224 days 17 hours.

This planet appears to us always near the sun, although she recedes from him almost double the distance of Mercury; when she is in that part of her orbit which is west of the sun, she rises before him in the morning, and is called *Lucifer*, or the morning star; and when she is in the eastern part of her orbit, she shines in the evening after he sets, and is called *Vesper*, or the evening star.

The EARTH, or planet which we inhabit, is about 7916 English miles in diameter, and is about 95 millions of miles from the sun; it performs a revolution through its orbit in 365 days 6 hours, which period is called a *year*, and revolves round its axis, from west to east, in 24 hours, which occasions the apparent diurnal motion of the sun, and all the heavenly bodies round it, from east to west, in the same time; it is of course the cause of their rising and setting, of day and night. The axis of the earth is inclined 23° 28′ from a perpendicular to the plane of its orbit, and keeps in a direction parallel to itself throughout its annual course, which causes the return of spring and summer, autumn and winter. Thus the diurnal motion gives us the grateful vicissitude of day and night; and the annual motion, the regular succession of the seasons. (See Plate VI. Figure 2.)

The earth is attended by a satellite called the MOON, whose diameter is about 2160 miles, her mean distance from the centre of the earth above 237,000 miles; she goes round her orbit in 27 days 8 hours, revolving round her axis in the same time; but the interval between each new moon is 29½ days; the former of these periods is termed a *periodic month*, and the latter a *synodic month*, or *lunation*.

As the moon, like the other planets, is an opaque body, and borrows her light from the sun, only one hemisphere is enlightened by the solar rays: hence she puts on various appearances, called *phases*, during her monthly course round the earth, as her illuminated side is more or less turned towards us: when she is in the same part of the heavens as the sun, her dark side being turned towards us, she is invisible, and this part of her period is called the *change*, or time of *new moon*; in a few days after, as she advances to the eastward of the sun, we see a small part of her enlightened face, and she assumes a horned appearance, the *cusps* or points being turned from the sun towards the east. When she has advanced 90° to the eastward of the sun, we then see half her illuminated face, and she is then said to be in her *first quarter*; as she proceeds on her journey, more of her enlightened

side becomes visible, and she appears of an oval or gibbous form. At length, when she is in opposition to the sun, she presents to us the whole of her enlightened face, and this is called the time of *full moon*. In performing the other half of her revolution, she wanes, and exposes less and less of her enlightened side, till she entirely disappears, and comes again in conjunction with the sun. (See Plate VII. Figure 1.)

When the moon, at the time of conjunction, is directly between the sun and the earth, she will intercept a part of the sun's rays, and thence cause an *eclipse of the sun*; and when, in opposition, the earth is directly between her and the sun, she will pass through the shadow of the earth, and cause an *eclipse of the moon*. These eclipses would happen every revolution of the moon round the earth, if their orbits were in the same plane; but the moon's orbit is inclined to the earth's in an angle of about 5 degrees, crossing it in two opposite points, called the *moon's nodes*; hence eclipses of the sun and moon can happen only when the moon is in or near one of the nodes, she being, at all other times, above or below the plane of the earth's orbit. (See Plate VII. Figure 2.)

Mars is the least bright and elegant of all the planets, being of a dull red or fiery colour, supposed to arise from the density of his atmosphere; his diameter is 4100 miles; his distance from the sun 142 millions of miles; his periodic revolution is performed in about 687 days; and he revolves round his axis in 24 hours 40 minutes.

Mars, as well as all the other superior planets, is not subject to the same limitations in his apparent motion as Mercury or Venus, but appears sometimes near the sun, and at other times in opposition to him.

Vesta was discovered by Dr. Olbers, of Bremen, on the 29th of March, 1807; its distance from the sun is about 225½ millions of miles, and the length of its year, 3 years, 240 days, 5 hours. This planet appears like a star of the 5th magnitude.

Juno was discovered by Mr. Harding, of Lilienthal, in the Duchy of Bremen, on the 1st of September, 1804. It appears like a star of the 8th magnitude; is distant from the sun about 253 millions of miles, and performs its revolution in 4 years, 131 days.

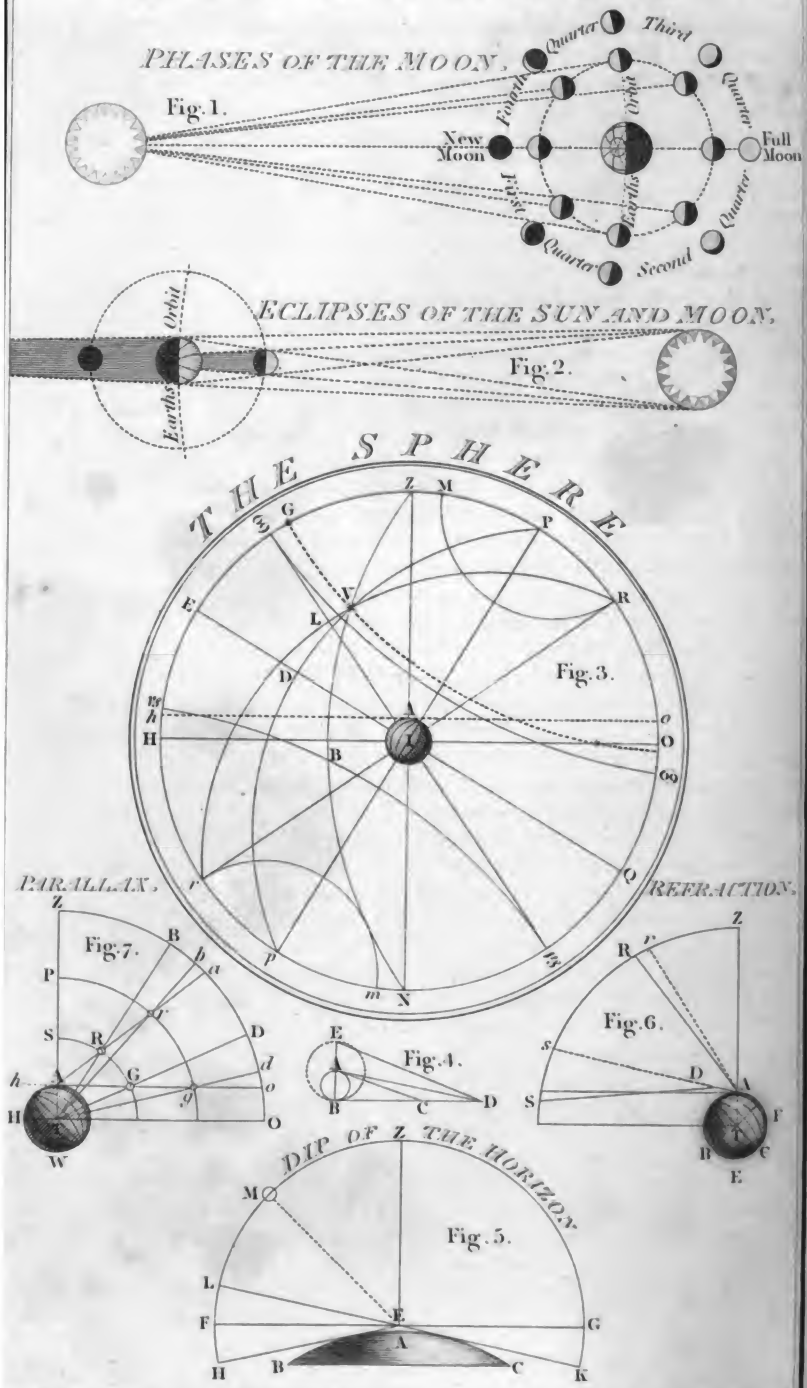
Piazzi, or Ceres, was discovered by M. Piazzi, the Astronomer Royal, at Palermo, in Sicily, on the 1st of January, 1801. Its periodic revolution is 4 years, 221 days, 13 hours; its diameter, as computed by Dr. Herschel, is about 162 miles, and its distance from the sun about 263 millions of miles. Ceres appears no larger than a star of the 8th magnitude, and therefore cannot be seen with the naked eye.

Pallas was discovered by Dr. Olbers, at Bremen, on the 28th of March, 1802; it is distant from the sun near 263 millions of miles, and performs its revolution round it in 4 years, 221 days, 17 hours. Pallas appears like a star of the 7th magnitude, and its diameter is about 110 miles*.

Jupiter is the largest of all the planets, and is easily distinguished by his peculiar magnitude and light. His diameter is nearly 90,000 miles; his distance from the sun above 485 millions of miles; and he performs his

* Vesta, Juno, Ceres, and Pallas are called Asteroids.

# ASTRONOMY.




Noric delin.t

J. Dower Sculp.

periodic revolution in 4332½ days, or nearly 12 years. Jupiter completes his diurnal revolution in 9 hours and 56 minutes.

This planet is attended by four satellites, invisible to the naked eye, but through a telescope they make a beautiful appearance. In speaking of them, we distinguish them according to their places, into the first, the second, &c. The eclipses of these are of considerable use in determining the longitude of places on the earth. In viewing Jupiter through a telescope, we find several streaks or lines over his equatorial parts, which are called his *belts:* these are supposed to arise from the swiftness of his diurnal motion, which draws his clouds and vapours into those forms.

SATURN was reckoned the most remote planet of our system, before the discovery of the planet Herschel, now called Uranus. He shines but with a pale and feeble light; his diameter is about 76068 miles; his distance from the sun above 890 millions of miles, and his periodic revolution in his orbit is performed in about 29 years, 167 days. Saturn revolves round his axis in 10 hours, 29 minutes, and is attended by seven satellites.

This planet is surrounded by a large, broad, double, and luminous ring, at a distance from it equal to the breadth of the ring. This phenomenon is quite different from all others in the planetary system, and appears intended to increase the quantity of light received from the sun, which, on account of the vast distance of the planet, must be very small.

URANUS, or, as it is sometimes called, the GEORGIUM SIDUS, was discovered on March the 13th, 1781, by Dr. Herschel; though there are many reasons to suppose it had been seen before, but had been considered as a fixed star. Its diameter is about 35112 miles; its distance from the sun upwards of 1800 millions of miles, and its periodic revolution in its orbit is performed in 83 years and 52 days. This planet is attended by six satellites, which were likewise discovered by Dr. Herschel.

The number of COMETS that has been recorded in history is very great, amounting to several hundreds. One of the most remarkable of these erratic bodies is that which appeared in the years 1531, 1607, and 1682, and was predicted by the celebrated Dr. Halley to reappear in the year 1759, which it actually did; passing its perihelion, or nearest distance from the sun, on the 12th of March in that year, its periodical revolution being made in about 76 years. The next return of this comet to its perihelion has been calculated by M. De Pontécoulant, a French astronomer, to take place on the 7th of November 1835.

## OF THE SPHERE.

Although the celestial bodies are placed at different distances from the earth, as we have just seen, yet an observer living upon the earth, is not naturally sensible thereof, but imagines them all to be situate in one concave surface, of which the earth is the centre.

Likewise, though in reality the cause of day and night is the rotation of the earth round its own axis; and of the seasons, its motion through its own orbit in a year; yet to a spectator on the earth these appear to be effected by the motion of the sun or heavens.

And as, in most astronomical problems, it is the apparent or relative motions only that we have to determine, therefore, for the ease of calculation,

and since it amounts to the same thing whichsoever way these appearances are effected, astronomers consider it more convenient to suppose all celestial objects placed in one concave sphere, as above, and to ascribe to them all the motions which they seem to have, while the earth is considered as being at rest in the centre.

In order to point out the positions of the heavenly bodies in the celestial sphere, certain points, lines, and circles are supposed to be described thereon.

Circles upon a sphere are either great or lesser. A *great circle* is that whose plane passes through the centre of the sphere. A *lesser circle* is that whose plane does not pass through the centre of the sphere: hence all great circles upon a sphere divide it equally, and all lesser circles divide it unequally.

Those two points on the surface of a sphere, which are equidistant from every part of the circumference of one of its great circles, are called the *poles* of that great circle.

If we imagine the axis of the earth produced to the celestial sphere, it is then called the *axis of the heavens*, and its extremities mark out two points in the sphere, which are called the *celestial poles*, or the *poles of the world:* one is termed the *north pole*, and the other the *south pole.* It is about these points that all the heavenly bodies appear to have a diurnal revolution.

The plane of the equator, in like manner produced to the heavens, forms a circle called the *celestial equator*, or *equinoctial*, whose poles are those of the world. This circle divides the heavens into two equal parts, called the *northern* and *southern hemispheres.*

Any celestial body situated in the equinoctial will appear to describe a great circle in the heavens, and those bodies which are situated north or south of it, will describe small circles: those stars situated at either pole will appear at rest.

The circle which bounds the view of a spectator, at sea, or on an open plane, is termed the *apparent*, or *visible horizon;* a circle whose plane passes through the eye of an observer, perpendicular to a plumb-line hanging freely, is called the *sensible horizon;* and a circle parallel to this, passing through the centre of the earth, is the *rational horizon:* these two circles in the sphere of the fixed stars may be considered as one and the same*.

The *zenith* of a place is that point in the heavens immediately above the place, and the *nadir* is that point immediately under it. Hence the zenith and nadir are the poles of the rational horizon.

*Azimuth*, or *vertical circles*, are great circles passing through the zenith and nadir, and therefore intersect the horizon at right angles. That vertical circle which passes through the east and west points of the horizon, is called the *prime vertical.*

*Celestial meridians*, or *circles of right ascension*, are great circles passing through the poles of the world, and cutting the equinoctial at right angles. Twenty-four of these circles, which divide the equinoctial into equal parts, each containing 15 degrees, are called *hour-circles.*

* For the division of the horizon into points, &c. see the Mariner's Compass, opposite page 62.

The *meridian of a place* on the celestial sphere is that vertical circle which passes through the poles, crosses the equinoctial at right angles, and intersects the horizon at the north and south points. This circle is the terrestrial meridian of a place extended to the heavens: it divides the heavens into two hemispheres, termed the *eastern* and *western*. When the sun is upon the meridian of a place above the horizon, it is noon; and under the horizon, it is midnight. On this circle the latitude of a place is reckoned, being always equal to the elevation of the pole above the horizon, or to the distance of the zenith from the equinoctial.

The *altitude* of a celestial object is an arch of a vertical circle intercepted between the centre of the object and the horizon.

The *zenith distance* is an arch of a vertical circle contained between the object and the zenith. When the object is on the meridian, its altitude, or zenith distance, is called the *meridian altitude* or *meridian zenith distance.*

The *azimuth* is an arch of the horizon, contained between the azimuth, or vertical circle, passing through the centre of the object, and the meridian of the place.

The *amplitude* is an arch of the horizon, contained between the centre of the object, when rising or setting, and the east or west points of the horizon.

The *ecliptic* is that great circle in the heavens which the sun appears to describe in the course of a year, and is the orbit of the earth extended to the celestial sphere. It is inclined to the equinoctial, in an angle of about 23° 28′, called the *obliquity of the ecliptic*, and cuts it in two points diametrically opposite, called the *equinoctial points.* Those two points of the ecliptic, 90 degrees distant from the equinoctial points, are called the *solstitial points.*

The ecliptic is divided into twelve equal parts, called *signs*, each containing 30 degrees: these are thus marked and named.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Aries | ♈ | 4. | Cancer | ♋ | 7. | Libra | ♎ | 10. | Capricornus | ♑ |
| 2. | Taurus | ♉ | 5. | Leo | ♌ | 8. | Scorpio | ♏ | 11. | Aquarius | ♒ |
| 3. | Gemini | ♊ | 6. | Virgo | ♍ | 9. | Sagittarius | ♐ | 12. | Pisces | ♓ |

The first six signs, being on the north side of the equinoctial, are termed *northern signs;* and the last six, on the south side, are called *southern signs*

The two points of the ecliptic which coincide with the equinoctial, are the beginning of Aries and Libra; the former of these is called the *vernal equinox*, and the latter the *autumnal equinox.*

The two solstitial points are situated at the beginning of Cancer and Capricorn, and are called the *summer* and *winter solstices.*

That great circle which passes through the equinoctial points and the poles of the earth, is called the *equinoctial colure;* and that great circle which passes through the solstitial points and the poles of the earth, is called the *solstitial colure.*

The sun enters the beginning of Aries about the 21st of March; he then moves forward in the ecliptic, and advances towards the north pole till he enters Cancer, which happens about the 22d of June; then, continuing

his motion according to the order of the signs, he apparently recedes from the north pole, and about the 23d of September enters Libra; still advancing in the ecliptic, he gets nearer to the south pole till he enters Capricorn about the 22d of December; after which, returning to the northward through the last three signs, he again enters Aries, and thus completes his annual course.

The *zodiac* is a space in the heavens extending about 8 degrees on each side of the ecliptic, like a belt or girdle, within which all the planets appear to perform their revolutions.*

*Circles of longitude* in the celestial sphere are great circles passing through the poles of the ecliptic, and therefore cut the ecliptic at right angles.

The *right ascension* of a celestial body is an arch of the equinoctial, contained between the first point of Aries and that point of the equinoctial which is cut by a meridian passing through the object.

The *ascensional difference* is an arch of the equinoctial, intercepted between the sun or star's meridian and that point of the equinoctial that rises with the object.

The *oblique ascension* or *descension* is the sum or difference of the right ascension and ascensional difference.

The *declination* of an object is an arch of a meridian contained between the equinoctial and the centre of the object. It is called north or south declination, according as the object is on the north or south side of the equinoctial.

The *polar distance* is an arch of the meridian contained between the centre of the object and either pole of the equinoctial.

The *latitude* of any object in the heavens is an arch of a circle of celestial longitude intercepted between the object and the ecliptic, and is called north or south, according as the object is north or south of the ecliptic.

The *longitude* of a celestial body is an arch of the ecliptic, intercepted between the first point of Aries and a circle of longitude passing through the centre of the object.

The *tropics* are two lesser circles parallel to the equinoctial, at about 23° 28′ distance from it, touching the ecliptic at the solstitial points: the northern tropic touches the ecliptic at the beginning of Cancer, and is thence called the *tropic of Cancer;* the southern tropic, touching the ecliptic at the beginning of Capricorn, is therefore called the *tropic of Capricorn.*

The *polar circles* are two lesser circles, about 23° 28′ distant from the poles of the equinoctial: that about the north pole is called the *arctic circle,* and the other the *antarctic circle.*

In order to illustrate the preceding definitions, let the circle ZHNO (Plate VII. Figure 3) represent the celestial meridian, Z the zenith, and N the nadir, of a place at A; *ho* the sensible horizon of the place, which may be considered as coinciding with HIO, the rational horizon, the north and south points being O and H, and the east and west points at I; and ZBN an azimuth or vertical circle, cutting the horizon in B; likewise let the

* Excepting the newly-discovered Planets, or Asteroids—Vesta, Juno, Ceres, and Pallas.

line P *p* be the celestial axis, whose pole P is elevated above the rational horizon equal to the latitude of the place. Now, if V be considered as the place of a star in the heavens, V B will be its altitude, V Z its zenith distance, H B its azimuth from the south, or B O from the north. If the star be supposed to rise or set at F, the arch F I will be its amplitude from the east or west; and if the star be at G, on the meridian, G H will be its meridian altitude, and G Z its meridian zenith distance.

Again, let P *p* represent the celestial axis, as before; the circle Z H N O, the solstitial colure; E Q the equinoctial, of which P*p* are the poles; P D *p* a circle of right ascension; ♋ ♈, the ecliptic; R *r* its poles; R L *r* a circle of longitude; ♋ ♋ the tropic of Cancer; ♑ ♑ the tropic of Capricorn; R M the arctic circle; and *r m* the antarctic circle. Then if V be the place of a star, V D will be its declination; V P or V *p* its polar distance; L V its latitude; and I L its longitude.

## THE DIAMETER OF THE SUN, MOON, &c.

The apparent diameter of the sun, moon, &c. is the angle under which they appear to an observer situated on the earth; the quantity of which depends upon the real magnitude of the object, and its distance from the observer. Thus, let A B (Plate VII. Figure 4) represent the real diameter of a distant object, the eye being at C; then the angle A C B is its apparent diameter: now if the eye be removed further from the object, as to D, its apparent diameter will be the angle A D B, which is evidently less than the angle A C B; likewise if the real diameter be increased to E, its apparent diameter will likewise increase, for the angle E D B is greater than the angle A D B.

The sun's apparent semidiameter is set down in Page II. of each Month in the Nautical Almanac, for every day; but its mean semidiameter, which is 16′, is used in common practice, as it never deviates half a minute from that quantity. The moon's semidiameter varies considerably during her monthly revolution round the earth, and is set down for every 12th hour in Page III. of each Month in the Nautical Almanac. The apparent semidiameter there given is the angle under which it would be seen when in the horizon, or from the centre of the earth; but since the moon is nearer the observer, by a semidiameter of the earth, when in the zenith than when in the horizon, and as this difference bears a sensible proportion to the moon's distance from the earth's centre,* the semidiameter given in the Almanac is to be increased by a quantity, called the augmentation, depending on its altitude, which is contained in Table VII.

The distance of the sun from the earth being immense when compared with the earth's semidiameter, the augmentation of the sun's apparent semidiameter is therefore insensible. The apparent semidiameter of a planet is so small, that it is seldom noticed in calculations. The fixed stars have no sensible apparent magnitude, even when viewed through the most powerful telescopes.

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* The moon is about 60 semidiameters of the earth distant from the earth's centre.

## DEPRESSION OF THE HORIZON.

The *depression*, or, as it is generally called, the *dip* of the horizon, is the angle contained between the sensible and apparent horizons, the angular point being the eye of the observer. Now as the altitudes of all celestial bodies observed at sea, are measured from the apparent horizon, which is below the sensible by a quantity depending on the height of the eye, these altitudes are greater when taken by a fore observation, and less when observed by a back observation, than they should be, by a quantity equal to the angle contained between the two horizons. Thus, let BAC (Plate VII. Figure 5) represent part of the surface of the earth, and AE the height of the observer's eye; then FEG will represent the sensible, and EH the apparent horizons; and therefore the angle FEH will be the depression, or dip, of the apparent below the sensible horizon. Let M be an object whose altitude is to be observed by bringing its image in contact with the apparent horizon; then will the angle MEH be the observed altitude, which is greater than the angle MEF, the altitude from the sensible horizon, by the angle FEH. In the back observation the observed altitude is MEL, to which the angle HEF, equal to GEK, must be added, to obtain the altitude above the sensible horizon FE.

The dip of the horizon is affected by terrestrial refraction, which, according to Dr. Maskelyne, amounts to $\frac{1}{10}$ the whole angle; but several astronomers differ in opinion respecting the quantity. In Table V. of this Work, which contains the dip answering to different heights of the observer, $\frac{1}{10}$ is allowed on the whole angle.

## REFRACTION.

The rays of light which proceed from a celestial body, on entering the atmosphere in an oblique direction, are bent out of their rectilinear course, and incline more and more towards the centre of the earth as they pass deeper into the atmosphere, and hence enter the eye of an observer in a different direction from that of the object, and make it appear higher than its real place. The difference between the real and apparent places of the heavenly bodies, as affected by the passage of the rays of light through the atmosphere, is called the *refraction* of the object. Let ABC (Plate VII. Figure 6) represent the surface of the earth, on which the observer stands at A, and DFF the surrounding atmosphere: now the rays of light which proceed from an object at Z in the zenith, falling perpendicularly on the atmosphere, are not refracted thereby, but continue in the same direction till they reach the eye of the observer. But if the rays proceed from a body not in the zenith, as at R, they fall on the atmosphere obliquely, and are bent or refracted into a curve inclining towards the earth's centre at T; and as the observer perceives objects in the direction that the rays proceeding from them enter the eye, he therefore imagines the body R to be at *r*; the difference of these places, or the arch R *r*, is the refraction of the object in altitude. Thus also if the rays from a star at *s* pass on to the eye by a curve-line DA, the observer judges that star to be in the direction of the side of this curve, terminating at the eye; that is, he conceives it to be at *s*,

in the direction *s* A, touching the curve at the point A, where it enters the eye.

The more obliquely the rays enter the atmosphere, the more they will be bent out of their rectilinear course, and hence the greater will be the refraction. The quantity of refraction likewise increases with the density of the atmosphere.

From what has been said, it follows that an object at the zenith is not subject to refraction; but that, as the distance from the zenith increases, the refraction becomes perceptible, and is proportionably greater as the body observed is further from the zenith, until it reaches the horizon, where the refraction is greatest. Also that, by the effect of refraction, the heavenly bodies appear more elevated above the horizon than they really are; and therefore the amount of refraction is to be subtracted from the apparent altitude of an object: in consequence of this, it likewise happens that the sun, stars, &c. may be actually below the horizon when they are seen above it; and hence they appear to rise sooner, and set later, than they would otherwise do.

## PARALLAX.

We have already observed, that the sensible and rational horizons may be considered as coinciding, when extended to the sphere of the heavens. This assumption will lead us to no sensible error with respect to the stars, which are at such an immense distance from us, that the earth in comparison is, as it were, but a mere point; but with respect to the sun, moon, and planets, the earth's semidiameter must be taken into consideration, in deducing our conclusions from observations made upon those bodies.

The situation of a celestial body, when viewed from the surface of the earth, is called its *apparent place;* and that part of the heavens where it would be seen, if observed at the same time from the centre of the earth, is called its *true place.* The difference between the true and apparent places is termed the *parallax* of the object.

In order to illustrate the nature of parallax, let A H W (Plate VII. Figure 7) represent the earth, A the place of an observer on its surface, whose sensible horizon is *h o*, rational horizon H O, and zenith at Z; also let S G be part of a vertical circle, whose radius is the distance of the moon from the earth's centre; P *g* part of a vertical circle, whose radius is the distance of a planet from the earth's centre, and Z O a vertical circle in the sphere of the stars. Now, to a spectator at A, if the moon appear in B, its apparent place in the heavens will be at *a;* but if viewed from the centre T, its true place will be at the point B: the difference of these places, measured by the arch *a* B, is its *parallax in altitude*

But if the moon be in the sensible horizon at G, its apparent place will be at *o*, and its true place at D; the arch *o* D is called its *horizontal parallax.* Moreover, if *g* be the place of a planet in the horizon, the arch *o d* will be its horizontal parallax; and if its place be at *r*, the arch *a b* will be its parallax in altitude.

The parallax of an object is greatest at the horizon, and gradually diminishes as the body rises above the horizon, until it comes to the zenith,

where the parallax vanishes. Thus *o* D and *o d*, the horizontal parallaxes of G and *g*, are greater than *a* B or *a b*, the parallaxes of R and *r*; and the objects at S or P, seen from A or T, will appear in the same place Z, or the zenith. The parallaxes of different objects are less or greater, as those objects are more or less distant from the earth. Thus the parallax *o* D of the moon G, is greater than the parallax *o d* of the planet *g*. It is likewise evident from the Figure, that the altitude of an object seen from the earth's surface, is less than it would be if seen from the centre; hence the parallax is to be added to the apparent altitude, in order to obtain the true altitude.

The moon's parallax is greater than that of the other heavenly bodies, owing to its being nearer the earth; at the horizon it varies from about 61′ 32″ to 53′ 52″, and is set down in Page III. of each Month in the Nautical Almanac. The sun's mean horizontal parallax is $8\frac{5}{4}''$; that of the planets is variable, according to their distance from us in the different parts of their orbits.

# TIME.

*Time* is a part of duration, and is measured by the motions of the heavenly bodies. It is divided into years, months, days, hours, &c.

A *day* is the interval between two successive transits of the sun, moon, or a star; and is denominated either a solar, lunar, or sidereal day, according to the name of that body to which it is referred.

A *sidereal day* is the interval between the transit of a star over a meridian, and its return to the same; and since the revolution of the earth on its axis is always performed in the same portion of time, the sidereal days will be of equal length. The day is divided into 24 sidereal hours, and these again are subdivided into sidereal minutes and seconds. The sidereal day commences when the first point of Aries passes the meridian, and continues until its return to the same. This mode of reckoning is used by Astronomers in their observatories, where there is generally a clock pointing out sidereal time, by which they ascertain the right ascensions of the heavenly bodies, as they pass the meridian of the place.

A *solar or apparent day* is the interval between the sun's departure from, and return to the same meridian. It is divided into 24 solar hours, and these again are subdivided into minutes and seconds: any portion of this day is called *true apparent or solar time*, and is that which is shewn by a sun-dial.

The length of the solar day being subject to continual variations on account of the eccentricity of the earth's orbit, and the obliquity of the ecliptic to the equinoctial, Astronomers, with the view of obtaining a convenient and uniform measure of time, have recourse to what they call a *mean solar day*, the length of which is equal to the mean, or average, of all the apparent solar days in a year; such as would be shewn by the sun if it moved always uniformly in the equinoctial: a clock, or chronometer, thus set, is said to be adjusted to *mean time*.

A mean solar day is longer than a sidereal one; for as the sun, in its apparent annual motion, advances in the ecliptic nearly a degree eastward every day, it will take more time than a fixed star to return to the same meridian; the mean solar day exceeding the sidereal day by 3 m. 56. 55s. of sidereal time.*

Since we can obtain only apparent time immediately from observations of the heavenly bodies, we must, in order to reduce this to mean time, apply a correction, call the *equation of time*, taken from Page I. of the given month in the Nautical Almanac, and applied as directed at the head of its column; but should we have occasion to reduce mean time to apparent time, then the equation is to be taken from Page II. of the Nautical Almanac, and applied as directed in that page.

Suppose, for example, it were required to find the time that should be shewn by a clock or chronometer, keeping mean time, on March 1st, 1835, at 3 hours after the sun has passed the meridian of Greenwich, that is, at 3 hours of apparent time, or what is generally called 3h. P.M.

In Page I. for the month of March, in the Nautical Almanac, the equation of time, on the first day, is 12m. 42.14s. at apparent noon, and the change in one hour, as shewn in the following column, is 0.497s.; this multiplied by 3, the number of hours since noon, gives 1.491s.† which being subtracted from 12m. 42.14s., because the equation is decreasing, leaves 12m. 40.65s. for the reduced equation: now, add this quantity to 3 hours, the apparent time, as indicated at the top of the column, and the sum 3h. 12m. 40.65s. is the mean time which ought to be shewn by the chronometer when the solar or apparent time is 3 hours past noon on March 1st, at the meridian of Greenwich.

On the contrary, if on the same day, at 3 hours of Greenwich mean time, we required the corresponding apparent time, then 12m. 40.76s., the equation of time, taken from Page II. of the Nautical Almanac, and reduced as above, is to be subtracted from the mean time, 3 hours, and the remainder 2h. 47m. 19.24s. will be the corresponding apparent time at Greenwich.

Again, suppose it were required to find the mean time, on April 15th, 1835, corresponding to 15h. 8m. 30s. apparent time at Greenwich. Now, in this case the equation of time on the preceding apparent noon is, by Page I. of the month in the Nautical Almanac, 0m. 7.94s. additive to the apparent time; but on the following noon it is 0m. 7.07s. subtractive; for the equation first decreases to 0, and then increases; consequently the sum of the two equations, 15.01s., is the amount of the change in 24 hours; the difference for one hour, 0.625, multiplied by 15, the hours since noon at Greenwich, will give the product, 9.37s., which being greater than 0m. 7.94s., the equation at the preceding noon, the latter is to be subtracted from it, and the remainder 1.43s. will be the reduced equation of time, to be subtracted from 15h. 8m. 30s., the given apparent time at Greenwich,

* A sidereal day is equivalent to 23h. 56m. 4.09s. of mean time; and a mean solar day contains 24 h. 3 m. 56.55 s. of sidereal time.

† The correction for the daily change or variation of the equation of time, may be found sufficiently exact for most practical purposes by Table LI.——See the Explanation to that Table.

(according to the precept at the head of the column); and the remainder 15h. 8m. 28.57s. will be the corresponding mean time at Greenwich.

A *lunar day* is the interval between the moon's passing a meridian and return to the same, its length being about 24h. 49m. of solar time: but the moon's motion in the heavens being very irregular, the lunar day is never employed as a measure of time.

There are three different modes of reckoning time with respect to the commencement of the day; these are denominated *civil*, *astronomical*, and *nautical*.

The *civil day*, which is that used by the generality of mankind, begins at midnight, and ends at the midnight following: it is divided into two parts of 12 hours each; the first are marked A. M., signifying *ante meridiem*, or before noon; and the latter twelve are marked P.M., signifying *post meridiem*, or afternoon.

The *astronomical day* commences twelve hours after the civil day, that is, at noon, and concludes at the following noon: it is generally reckoned through the 24 hours, from noon to noon; and what are by the civil, or common way of reckoning, called morning hours, are by Astronomers reckoned in succession from 12, or midnight, to 24 hours: for instance, 9 o'clock in the morning, July 3d, civil time, is July 2d at 21 hours astronomical time.

It thus appears that, from noon to midnight, the day of the month, and the hour of the day, are the same by both methods of reckoning; but from midnight to noon they differ; for at midnight, when the new civil day begins, the astronomical day of the same date will not commence till 12 hours after.

The *nautical* or *sea day* begins at noon, or 12 hours before the civil day, and ends at noon of the civil day; it is divided into two parts of 12 hours each, the former being marked P.M, and the latter A.M. This mode of reckoning arises from the custom of seamen dating their log for the preceding 24 hours, the same as the civil day; so that occurrences which happen, for instance, on Monday, 21st, afternoon, are entered in the log marked Tuesday, 22d. Hence the noon of the civil day, the beginning of the astronomical day, and the end of the nautical day, take place at the same moment.

Ships in the Royal Navy, and some merchantmen, date their log according to the civil mode of reckoning, calling the first 12 hours A.M., and the latter P.M., but make up the day's work as usual, from noon to noon, or at the middle of the civil day.

All the computations in the Nautical Almanac being made for astronomical time at the meridian of Greenwich, (the days commencing either at apparent or mean noon, as expressed at the top of the several pages), it will be necessary, before the quantities are reduced to the time of observation, to ascertain the corresponding time at Greenwich when the observation is taken. Now, by the diurnal revolution of the earth round its axis from West to East, all the heavenly bodies appear to move in a contrary direction, that is, from East to West, over 360° of longitude in 24 hours, which is at the rate of 15 degrees in one hour of time; consequently, at any place situated 15 degrees to the eastward of the meridian of Greenwich,

it will be noon at that place one hour before it is noon at Greenwich; but if the place be in 15 degrees of West longitude, it will be noon there one hour after it is noon at Greenwich, and in the same proportion for any other given longitude: hence we have the following rule for ascertaining the time at Greenwich corresponding to any given time under another meridian.

RULE. Reduce the given longitude into time by Table XIX., and add it to the astronomical time at the given place, if the longitude be West; but subtract it, if East; and the sum or remainder will be the corresponding Greenwich time.

In East longitude, when the longitude in time exceeds the time under the given meridian, add 24 hours to the latter, and subtract as before; then the remainder will be the time past noon of the preceding day.

In West longitude, when the sum of the longitude in time, and the time under the given meridian, exceeds 24 hours, take 24 hours from it, and the remainder will be the time past noon of the following day.

## EXAMPLE I.

What will be the time at Greenwich, on October 5th, when it is 6 hours past noon, in longitude 45° 30′ West?

| | h. | m. | |
|---|---|---|---|
| Time under the given meridian | 6 | 0 | |
| Longitude in time (XIX.) | 3 | 2 | West. |
| Corresponding time under the meridian of Greenwich | 9 | 2 | |

## EXAMPLE II.

Required the time at Greenwich, corresponding to July 21st, at 9h. 42m. 30s. A. M. (civil time), in longitude 76° 19′ East.

| | h. | m. | s. | |
|---|---|---|---|---|
| Astronomical time under the given meridian, July 20th | 21 | 42 | 30 | |
| Longitude in time (XIX.) | 5 | 5 | 16 | East. |
| Astronomical time at Greenwich, July 20th | 16 | 37 | 14 | |

## EXAMPLE III.

February 15th, being in longitude 115° 36′ E., an observation was taken at 2h. 48m. 26s. P. M.; required the corresponding Greenwich time.

| | h. | m. | s. | |
|---|---|---|---|---|
| Time of Observation at Ship, February 15th | 2 | 48 | 26 | |
| | 24 | | | |
| Ditto after noon, February 14th | 26 | 48 | 26 | |
| Longitude in time (XIX.) | 7 | 42 | 24 | East. |
| Greenwich time, February 14th | 19 | 6 | 2 | |

### EXAMPLE IV.

March 21st, at 6h. 46m. 17s. A. M. (civil time), in longitude 130° 40′ West; required the corresponding astronomical time at Greenwich.

| | h. | m. | s. | |
|---|---|---|---|---|
| Astronomical time under the given meridian, March 20th. | 18 | 46 | 17 | |
| Longitude in time (XIX.) | 8 | 42 | 40 | W. |
| Astronomical time at Greenwich, since noon, March 20th... | 27 | 28 | 57 | |
| | 24 | | | |
| Ditto at Greenwich, March 21st | 3 | 28 | 57 | |

### EXAMPLE V.

November 12th, 1835, in longitude 49° 17′ W., at 4h. 46m. 17s. P. M., apparent time; required the mean time at Greenwich.

| | h. | m. | s. | |
|---|---|---|---|---|
| Apparent time, in longitude 49° 17′ W. | 4 | 46 | 17 | |
| Longitude in time (XIX.) | 3 | 17 | 8 | W. |
| Apparent time at Greenwich | 8 | 3 | 26 | |
| Reduced equation of time (Page I. Naut. Alm.) | — | 15 | 42 | |
| Mean time at Greenwich | 7 | 47 | 43 | |

## WINDS.

THE air, or atmosphere, which encompasses our terraqueous globe, and extends several miles above its surface, is by its elasticity capable of being expanded, or of spreading itself so as to fill up a larger space than it before occupied, and of being condensed or compressed into a less space. The principal causes in producing these effects are heat and cold; the former rarefying or expanding, and the latter condensing or compressing the air: when, therefore, any portion of it becomes heated, the cooler or denser air from the neighbouring parts will acquire a motion towards the thinner, in order to restore the equilibrium, and thereby occasion those currents of air which are called *Winds*.

Although various causes may contribute to produce this inequality in the density of the atmosphere, yet the most general and permanent is the influence of the sun's rays, by which the air in the regions about the equator being heated to a greater degree, and consequently more rarefied than that which is nearer to either Poles, the more ponderous or dense air will have a motion from the north and south, in order to preserve the equilibrium; but as the sun is continually shifting to the westward, that part towards which the air tends, by reason of the rarefaction, is with him carried westward, and consequently the tendency of the whole body of air is that

way; hence a general easterly wind is formed, which being impressed upon all the air of a vast ocean, the parts impel one another, and so keep moving till the next return of the sun, by which so much of the motion as was lost, is again restored, and thus the easterly wind is made perpetual: the combination of these two currents of air acting at the same time, will produce a north-easterly wind in the northern hemisphere, and a south-easterly wind in the southern hemisphere.

If the whole surface of the globe were sea, these winds would constantly blow quite round the world without interruption; but as water is of a more even temperature than land, the latter will sometimes be hotter and sometimes cooler than the former, rarefying or condensing to a greater degree the air immediately above, whereby the air will be put in motion, the denser towards the lighter, in order to restore the equilibrium: hence when a considerable body of land intervenes, particularly in the tropical regions, new points of rarefaction and condensation take place, sufficiently powerful to counteract the former more remote, and therefore more feeble cause; for it is to be observed, that the atmosphere derives a greater portion of its heat, near the surface, from its communication with land and water, than from the direct influence of the sun.

Partial and temporary winds are likewise frequently produced by thunder-storms, or other electrical phenomena. The rays of the sun are also sometimes obstructed by clouds, or mists in particular places; and one part of the world, or even of a particular country, will consequently be less heated than another: in that case there will always be a current of air from the cold to the warm region. Besides this, the falling of rain, or other circumstances, produce occasional alterations in the temperature of the air; and whenever these take place in any country, they must be attended with wind.

In those parts of the Atlantic and Pacific Oceans which are remote from the influence of the land, between the limits of about 28 or 30 degrees of north and south latitude, there is a constant easterly wind, the cause of which we have already assigned in the preceding observations. On the north side of the equator the wind blows from between the north and the east, and on the south side from between the south and the east, inclining more to the north and south as they are further from the equator: these winds are denominated the N. E. and S. E. *trade winds.*

But we are not to conclude that the above limits are without exception; for both their direction and extent vary much with the season of the year. When the sun approaches the tropic of Cancer, the S. E. trade-wind prevails further to the northward of the line, inclining more to the south than the east, and the N. E. trade-wind more to the eastward; on the contrary, when he is in Capricorn, the N. E. trade-wind extends more to the southward of the equator, but inclining more to the northward, and the S. E. veers a little more to the eastward.

The S. E. trade-wind generally extends as far as 5 or 6 degrees to the northward of the line, and sometimes even to 7 degrees, according to the seasons: sometimes the N. E. and S. E. trade-winds almost meet each other, leaving very little space between them; and at other times there will

be an interval of several degrees subject to calms, squalls, thunder, lightning, and heavy rains. It has likewise been remarked, that between the trades, the wind frequently prevails from the S. W. quarter.

The trade-winds extend to higher degrees of latitude on the coasts of North and South America than on the coast of Africa, sometimes as far as 32 degrees on the North American coast, and to the same latitude south on the coast of Brazil; though they seldom exceed 28 degrees on the African side to the northward of the Cape of Good Hope.

Beyond the limits of the trade-winds, in both the northern and southern hemispheres, the winds are variable, but for the most part prevailing from the westward, or W. S. W. in the northern, and from the W. N. W. in the southern latitudes: these winds often extend to the Tropics, and sometimes even as far as the 20th degree of latitude.

The probable cause of the trade-winds thus changing to the opposite direction appears to be, that the rarefied air within the tropical regions being pressed upon by that which is cooler or denser, coming from the northward or southward, ascends to the upper part of the atmosphere, where the reflected rays of the sun has less influence, dispersing itself in order to maintain an equilibrium, and forming a contrary current at the commencement of the temperate zone, which produces the above-mentioned winds. But the above observation must be confined to particular seasons, within certain limits, and not be considered as invariably the case; for even in the South Atlantic Ocean, in those same parallels of latitude, the winds are light and variable, coming often from the S. E., and veering almost to every point of the compass.

The N. E. trade-wind in the Atlantic Ocean blows in a regular fresh gale at about 100 leagues from the coast of Africa; and it is remarked that, as ships approach nearer to the West Indies, this wind generally comes nearer to the east, so as seldom to deviate more than a point either to the northward or southward.

On the coast of Brazil the S. E. trade-wind is subject to periodical shiftings, according to the respective seasons: it blows there from N. E. to E. N. E. between September and March, and from S. S. E. to E. S. E. from March to September.

On the African coast, from Cape Blanco to Sierra Leone, the winds (excepting always land-breezes and storms) blow from the north, inclining rather from the westward than from the eastward. From Sierra Leone to Cape Palmas the ordinary course of the winds is from W. N. W., and beyond Cape Palmas, as far down as about 28 degrees of south latitude, from S. W. to South, inclining more to the southward or westward, according to the particular situation or bearing of the shores and lands.

The reason of these dispositions of the trade-winds towards the land will appear obvious, from the general principles already laid down, when we consider the nature of the coasts, and their situation with regard to the sun. The vast Continent of Africa, for instance, being violently heated by the sun, especially those parts near the equator, the incumbent air will be exceedingly rarefied; and the sea being much cooler than the land, the current of air must almost constantly come from the westward, to restore

the equilibrium; and it is to be observed, that the winds on the coast of Guinea actually acquire this direction towards the shore within 80 or 100 leagues, getting first more towards the south, then becoming full south, and afterwards shifting to the westward of the south. This part of the ocean is consequently much troubled with frequent calms, and with sudden and violent gusts of wind, known by the name of *Tornadoes*, which blow from all parts of the horizon.

In the Gulf of Guinea there is a periodical wind, called the *Harmattan*, which blows in a N. E. direction from the interior parts of Africa. The season in which it prevails, is during the months of December, January, and February; it comes on indiscriminately at any hour of the day, at any time of the tide, or at any period of the moon; and continues sometimes only a day or two, sometimes five or six days, and it has been known to last fifteeen or sixteen days. There are generally three or four returns of it every season: it blows with a moderate force, but not quite so strong as the sea-breeze. It has been further observed, that between the 4th and 10th degree of north latitude, and between the longitude of Cape Verd and the easternmost of the Cape Verd Islands, there is a tract of sea which seems to be condemned to perpetual calms, attended with terrible thunders and lightnings, accompanied with such frequent rains, that this part of the sea is called the *rains*. This appears to originate from the same cause as those we have already stated; for this tract being placed in the middle, between the westerly winds blowing on the coast, and the easterly trade-wind blowing to the westward of it, the tendency of the air is here indifferent to either, and therefore keeps its place, and makes a calm; and the weight of the incumbent atmosphere being diminished by the continual contrary winds blowing from hence, is the reason that the air is not able to support the vapours plentifully raised here by the heat, but lets it fall in frequent and copious showers.

All these circumstances duly considered will account for those circuitous passages which ships make in sailing from one distant port to another in the Atlantic Ocean, and for the difficulty they meet with in sailing to the southward, especially in the months of July and August, when the S. E. trade-winds usually extend to 7 or 8 degrees north of the equator, and not unfrequently vary so much as to blow from the south, and even a point or two to the west of the south; for in this case every mile that is then obtained, must be in the face of a constant trade-wind, directly opposing the track of the ship, and by an infinite degree of trouble, and constantly plying to windward. For if, on the one hand, a ship steers W. S. W., and gets the trade-wind more towards the east, she will be in danger of falling in too soon with the coast and shoals of Brazil; and if she steers E. S. E., she must fall in with the coast of Guinea, and cannot extricate herself from that situation but by running down east to the Island of St. Thomas; it is for this reason that India ships, both outward and homeward bound, pass the equator in the Atlantic between the longitudes of 18° and 23° West: by keeping this course, they never fall in with the coast of America, either going to the Cape of Good Hope, or returning from it, and at the same time they avoid the calms on the coast of Africa.

These circumstances likewise point out the only possible course for ships

to sail from the coast of Guinea for Europe; and that is, to steer away S.S E. or South, and with these courses to run off the shore, while the wind becomes more and more contrary. Though ships, when near the shore, can lie south on this coast, yet when they get more distant, they can only make good a S. E. course, and as they get further out, they will only make good an E.S.E. course; but they can generally make the Island of St. Thomas, or Cape Lopez, with these directions, when they will find the winds to the eastward of the south. They then set off westerly from the coast, and run on till they come to 4 degrees south latitude, by which time they will find a constant trade-wind from the S. E.

On account of these general winds, ships bound from England, or other parts of Europe, to the West India Islands, or to the southern parts of the coast of North America, even as far to the northward as Virginia, consider it as most advantageous to get to the southward as soon as possible; for on their reaching the latitude of 30 degrees, or thereabouts, where they get within the influence of the trade-winds, they can depend on having a steady gale from the eastward, so as to enable them to run before the wind. For the same reason, all ships returning from the West Indies, or the contiguous part of the coast of North America, endeavour to run up to 30 degrees north latitude, or even further north, where they first find the wind begins to be variable, so as to enable them to make to the eastward. Indeed, the most general and prevailing wind, without the northern limits of the trade-wind in the Atlantic Ocean, is between the south and west, and therefore fair for bringing ships to Europe.

Again, ships bound to India from America run to the eastward in the variable winds, so as to be in the longitude of 35 or 38 degrees West when in the latitude of 30 degrees North; thence they steer south-easterly towards the Cape Verd Islands, passing two or three degrees to the westward of them. Being then in the general track of the European Indiamen, they steer south-easterly, to cross the equator between the longitude of 18 and 23 degrees West, where meeting the S. E. trade-wind, they must brace up, and sail upon a wind till they get so far to the southward as to meet with the variable winds, when they may steer to the eastward.

Between the parallels of 28 and 40 degrees of south latitude in the Indian Ocean, as we have already observed is the case in the South Atlantic, the wind is variable, but most frequently blows between the N. W. and S. W.; it is on this account that outward-bound East India ships generally run down their easting on the parallel of 36 degrees South.

From the latitude of 28 degrees South to the equator, the S.E. trade-wind blows constantly without any considerable interruption in the Indian Ocean, as in the Pacific and Atlantic, between some few degrees to the eastward of Madagascar, as far nearly as the Island of Java; but in the other parts of the Indian Ocean, and in the adjoining seas, the winds divide the year into two seasons, or *monsoons**, blowing certain months in one direction, and the rest of the year in the opposite.

In the Mozambique Channel, between the Island of Madagascar and the coast of Africa, the monsoons prevail alternately; the S. W. begins in

* The word monsoon is derived from the Persian word *mousum*, which signifies season.

April, and continues till November: the N.E. then succeeds, and continues until April; but the S.W. monsoon in this channel is the fair season, and the wind sometimes varies towards the S.E. and E.S.E. on either coast, about the middle of November, where also there are in general regular land and sea breezes. The N.E. monsoon begins near the Comoro Islands and the north of Madagascar, but seldom extends beyond St. Augustine's Bay to the southward, towards which it commences only at the end of November.

To the north of the equator, in the whole extent of the seas comprised between the eastern coast of Africa, and the meridian which passes through the western part of Japan, the monsoons blow from the S.W. between the middle of April and the middle of October, and from the N.E. during the rest of the year, excepting only the Red Sea and the Gulf of Persia, which have particular winds; to which we might also add the Straits of Malacca, where the winds are generally shifting, and in which the monsoons do not blow for a long time.

In the Red Sea the winds blow almost nine months of the year from the southward, that is, from the end of August to the middle of May, and sometimes to the end of that month, when the wind changes to the North and N.N.W., and generally continues in that quarter to the end of August; but sometimes the land and sea breezes prevail.

In the Gulf of Persia the N.W. wind blows most part of the year, November, December, and January, being the only months when southerly winds are certain. These winds, however, are not so regular as those in the Red Sea, being often interrupted by fresh gales from the S.W., principally from Cape Mussendom, and sometimes by land-breezes.

In the Gulf of Siam, on the Coasts of Cambodia or Camboge, Cochin China, the Gulf of Tonquin, and China, the S.W. monsoon commences near the coast in the course of the month of April; but out at sea, in those parts, it does not change till a month later. It is for this reason that on the north part of Borneo, to the Islands of Palawan and Luconia, it is seldom known to blow constantly, but from the 1st to the 15th or 20th of May. As the S.W. monsoon continues only about six months, and commences near the coast, it there ceases first likewise, in the same manner, and is immediately succeeded by the N.E. monsoon. The winds in the China Seas are not so regular as in the Arabian Sea, and are frequently interrupted by violent and dangerous *tyfoons*.* These tyfoons are of the same nature with the hurricanes in the West Indies, both of which appear to arise from violent and sudden changes in the upper and lower regions of the air; and it has been remarked that they happen, for the most part, about the autumnal equinox, and are always preceded by calms and hot weather.

In that part of the Indian Ocean adjoining to New Holland, between the meridians of Sumatra and Java to the west, and New Guinea to the east, there is a regular monsoon, which sets in from the N.W. between the months of October and April; during the other months of the year the

* From the Chinese words *Ty*, great or powerful, and *Foong*, wind.

wind resumes its natural course of S.E. These winds are called the N.W. and S.E. monsoons.

The monsoons do not change suddenly from one point of the compass to the opposite; between the expiration of one, and the commencement of the other, the winds are light and variable, and sometimes calms prevail, until the regular monsoon commences, and acquires sufficient strength to blow steady.

The shifting of the N.E. and S.W. monsoons is frequently attended with violent squalls; for which reason ships between the coasts of Malabar and Africa, if bound to Bombay from the southward, never attempt to make the former coast at the breaking up of the N.E. monsoon, particularly in the month of May; hence, likewise, they avoid the Coast of Coromandel in the month of October: for it is a fact worthy of remark, that the bad weather month on the Coast of Malabar is the fine weather month on the Coast of Coromandel, and *vice versâ*, although these coasts are situate on the same peninsula.

The most obvious cause of the above periodical changes in the wind appears to be the situation of the sun in the ecliptic at the different seasons of the year; for when the sun approaches the Tropic of Cancer, the soil of Persia, Bengal, China, and the adjoining countries, becomes so much more heated than the sea to the southward of those countries, that the current of the general N.E. trade-wind is interrupted, so as to blow at that season from the south to the north, contrary to what it would do if no land were there; but as the high mountains of Africa, during all the year, are extremely cold, the low countries of India to the eastward of it becomes hotter than Africa in summer, and the air is naturally drawn thence to the eastward: hence it is that the wind in those parts blows from the S.W. between April and October, contrary to the trade-winds in the Atlantic and Pacific Oceans in the same latitudes; but when the sun retires towards the Tropic of Capricorn, these northern parts become cooler, and the general trade-wind assumes its natural direction from the N.E.

Upon the same principle we account for the monsoons adjoining New Holland, which we find is an immense tract of land to the S.E. of the Sunda and Molucca Islands; for when the sun is in the Tropic of Cancer, the current of air, even independent of the trade-wind, will move from the S.E., to restore the equilibrium to the N.W.; on the contrary, in the months of November, December, and January, whilst the sun is nearly vertical over a great part of New Holland, the current of air, through the Sunda and Molucca Islands, will come from the N.W., to fill up the vacuum made by the rarefication, and thus occasion an alternate S.E. and N.W. monsoon.

The cause of *land* and *sea breezes*, which prevail principally between the Tropics, and never extend above three or four leagues from the shore, may be explained after the same manner as the monsoons. For during the day the sea is not so much heated by the presence of the sun as the land, nor is it so much cooled during the night; therefore, when the earth begins to be violently heated in the course of the day, the cooler air from the sea will rush in towards the land, to supply the deficiency occasioned by the greater

rarefaction of the air; and hence arise the sea-breezes. On the other hand, the land becoming cooler than the water in the absence of the sun, the current of air, a few hours after sunset, flows from the land to the sea, and thus produces the land-breeze.

# TIDES.

A TIDE is that regular motion of the waters of the ocean by which they rise and fall in certain intervals of time. The rising of the water is called the *flux*, or *flood;* and its falling, the *reflux*, or *ebb*. When the water has attained its greatest height, it is said to be *high water;* and when it is done falling, it is called *low water*.

These periodical motions of the waters are effected by the unequal attraction of the sun and moon, but chiefly that of the latter object, on the different parts of the earth. For the discovery of the laws by which this general principle of attraction is governed, we are indebted to the great Sir Isaac Newton, who has demonstrated that the power of attraction diminishes as the distance increases, in proportion to the squares of those distances.

Now it is evident by the above law, that those parts of the earth nearest the moon, are more attracted by her than the central parts; and that the central parts will be more attracted than those which are farthest from her: and therefore the distance between the earth's centre and the waters upon its surface, under and opposite to the moon, will be increased; so that if the earth's surface were covered with water, it would assume a spheroidal, or egg-like figure, the longest diameter of which would be directed to the moon's centre. Hence those parts of the earth directly under and opposite the moon, that is, where the moon is in the zenith and nadir, will have the flood, or high water, at the same time; while those parts at 90 degrees distance, or where the moon appears in the horizon, will have the ebb, or lowest water, at that time. As the moon apparently shifts her position from east to west, in going round the earth every day, the longest diameter of the spheroid following her motion, occasions two floods and ebbs, in about every 24 hours and 49 minutes, which is the length of a lunar day; or the interval between the moon's passing the meridian of any place, and returning to the same.

The earth's diameter bears a considerable proportion to its distance from the moon, but is next to nothing when compared to its distance from the sun; therefore the difference of the sun's attraction on the sides of the earth under and opposite to him, is much less than the difference of the moon's attraction on the sides of the earth under and opposite to her, and consequently the moon must raise the tides much higher than they can be raised by the sun.

From this theory, it may be thought the tides ought to be highest directly under and opposite the moon; but we find that in open seas,

where the water flows freely, the moon is generally past the meridian when it is high water. The reason is obvious; for though the moon's attraction were to cease altogether, when she was past the meridian, yet the motion of ascent communicated to the water before that time, would make it continue to rise for some time after; much more must it do so when the attraction is only something diminished.

The times of high water do not always answer to the same distance of the moon from the meridian at the same places; but are variously affected by the action of the sun, which brings them on sooner when the moon is in her first and third quarters, and keeps them back later when she is in her second and fourth; because, in the former case, the tide raised by the sun alone, would be earlier than the tide raised by the moon; and in the latter case, later.

When the moon is in *perigee*, or at her nearest distance from the earth, she attracts strongest, and therefore raises the tides most; the contrary happens when she is in *apogee*, or at her greatest distance from the earth, because of her weaker attraction. At new moon, when the moon is in conjunction with the sun, the tides are raised by the joint attraction of both luminaries, and therefore will be highest; the same is the case at full moon, when the sun and moon are in opposition: for whilst the moon raises the tides under and opposite her, the sun acting in the same line, raises the tides under and opposite to him, whence their conjoint effect is the same as at the change, and in both cases occasions what are called *spring-tides*. But at the quarters, the sun raises the tides where the moon depresses them, and depresses them where they would be raised by the moon: hence it is the difference of their actions that produces the tides at the quarters, and these are called *neap-tides*. But these tides do not happen till a day or two after the above times; because in this, as in other cases, the effect is not greatest or least when the immediate influence of the cause is greatest or least, but some time afterward.

The sun being nearer the earth at the beginning than at any other time of the year, its attraction will then be most powerful; and of course about January the spring-tides will be greater than at any other time, and greatest of all if the moon at the same time should happen to be in perigee.

When the moon is in the equinoctial, the tides are equally high in both parts of the lunar day; but as the moon declines from the equinoctial towards either Pole, the tides are alternately higher and lower at places having north or south latitude. Whilst the moon has north declination, the greatest tides in the northern hemisphere are when she is above the horizon, and the reverse whilst her declination is south.

The tides rise higher at any place in proportion as the moon is nearer to the zenith or nadir of that place at the time of her passing the meridian; because the action of the moon is there strongest: hence the tides are greater between the Tropics than at any other parts, and less near the Poles.

All the above particulars would exactly obtain were the whole surface of the earth covered with deep water; but since there are multitudes of islands besides continents lying in the way of the tide, which interrupt its direct course, there arises a great variety of other appearances which require

particular solutions, wherein the situation of the shores, straits, shoals, winds, and other things must be considered. For instance, as the sea has no known passage between Europe and Africa, let them be supposed one continent, extending from Weigate Straits, in latitude 78° North, to the Cape of Good Hope, in latitude 34° South; the middle of these two would be in about 19° North, near Cape Blanco on the west coast of Africa. But it is impossible the flood-tide should set to the westward upon the western coast of Africa (for the general tide, following the course of the moon, must set from east to west), because the continent for above 50 degrees, both northward and southward, bounds that sea on the east; therefore, if any regular tide, proceeding from the motion of the sea, from east to west, should reach this place, it must come either from the north of Europe southward, or from the south of Africa northward.

This opinion is further corroborated, or rather fully confirmed, by common experience, which shews that the flood sets to the southward along the west coast of Norway, from the North Cape to the Naze, or entrance of the Baltic Sea, and so proceeds to the southward along the east coast of Great Britain, and in its passage supplies all those ports which lie in its way, one after another. The coast of Scotland has the tide first, because it comes from the northward to the southward. On the full and change days it is high water at Aberdeen at 0h. 45m., but at Tynemouth Bar not till 2h. 50m.; rising thence to the southward, it makes high water at the Spurn 30m. after 5h.; at Yarmouth Roads 40m. after 8h.; at Harwich 11h. 30m.; at the Nore Light 30m. after 12h., and at London Bridge at 2h. 7m., all in the same day. And although this may seem to contradict the hypothesis of the natural motion of the tides being from east to west, yet as no tide can come west from the main continent of Norway or Holland, it is evident the tide we have been tracing, by its several stages from Scotland to London, is supplied by that tide, the original motion of which is from east to west. As water always inclines to its level, it will in its passage fall to any other point of the compass, to fill up vacancies where it finds them; and yet not contradict, but rather confirm the hypothesis.

From these circumstances it is evident, that the direct course of the rising tides from east to west being interrupted by the land lying in their way, they are often obliged to make a long circuit, and to flow in various directions; whence the setting of the tides, and the times of high water, are different at different places.

Lakes and inland seas, such as the Caspian Sea, the Mediterranean, and the Baltic Seas, have little or no sensible tides; for they are usually so small, that the attractive influence of the sun and moon is nearly equal at both extremities, and cannot therefore sensibly affect the water.

When the time of high water at any place is mentioned generally, it is to be understood of the time when it is high water at that place on the day of new or full moon; or the time past noon when it is high water on the day on which the sun and moon are together on the meridian of the place. Among pilots it is customary to reckon the time of flood, or high water, by the point of the compass the moon is supposed to bear on at that time, allowing three-quarters of an hour for each point. In places,

for instance, where it is flood at noon on the days of full and change, the tide is said to flow north and south, or at 12 o'clock. In places where the moon is supposed to bear 1, 2, 3, 4, or more points to the east or west of the meridian, when it is high water on the same day, the tide is said to flow on such a point; so if the moon is supposed to bear S. E. at flood, it is said to flow S. E. and N. W., or 3 hours before the moon comes to the meridian, that is, at 9 o'clock; if she bears S. W., it flows S. W. and N. E., or at 3 hours after the southing; and in like manner for other points of the moon's bearing. But this absurd custom of reckoning the tides by the bearing of the moon, should be exploded, as founded in error; for the moon takes a greater or less portion of time in passing over any given number of points of the compass.

In some places it is high water on the shore, or by the ground, while the tide continues to flow in the stream or offing; and according to the length of time it flows longer in the stream than on the shore, it is said to flow tide, and such part of tide, allowing 6 hours to a tide. Thus 3 hours longer in the offing than on the shore make tide and half-tide; an hour and a half longer make tide and quarter-tide; three-quarters of an hour longer make tide and half-quarter-tide, &c.

The common method of finding the time of high water at any place is contained in the following particulars.

## OF LEAP YEAR.

The length of the solar year being nearly 365 days 6 hours, and the common year containing only 365 days, one day is added every fourth year to the month of February, making that year contain 366 days, which is called *bissextile*, or *leap* year, and is found as follows:

### *To find the Leap Year.*

RULE. Divide the given year by 4, and if there be no remainder, it is leap year; but if 1, 2, or 3 remain, they shew that it is so many years after leap year.

EXAMPLE. The year 1838, divided by 4, gives 459, and the remainder 2, which shews that it is the second year after leap year.

## OF THE EPACT.

The Epact is the moon's age at the beginning of the year: it increases 11 every year, being the excess of the solar year of 365 days, above the lunar year of 354 days, or 12 lunations. It is also observed, that the moon goes through all her variety of aspects, with respect to the sun, in the course of 19 years; so that at the end of that period, which is called the *lunar cycle*, the new and full moons return on the same days of the month, and nearly at the same hours. Hence the following Rule:

### *To find the Epact.*

RULE. Divide the given year by 19; multiply the remainder by 11, and the product will be the Epact, if it does not exceed 29; but if it does, divide the product by 30, and the last remainder will be the Epact.

EXAMPLE. Required the Epact for the year 1838.

1838, divided by 19, gives 96 for the quotient, and 14 for the remainder, which multiplied by 11, gives 154; this, divided by 30, gives the quotient 5, and the remainder 4; which remainder is the Epact for the year 1838.

## OF THE NUMBER FOR THE MONTH.

The Number, or Epact for the Month, is the moon's age at the beginning of that month, when it is new moon on the 1st of January; hence,

### *To find the Number of any given Month.*

RULE. Divide the number of days contained in the preceding months, reckoning from the beginning of January, by 29.5, or rather 29.53 (the period of a mean lunation in days and decimal parts), and the nearest whole number to the remainder is the Epact, or Number for the Month required.

EXAMPLE. Required the Number, or Epact, for September.

The days contained between the beginning of January and the beginning of September are 243; this number, divided by 29.53, gives the quotient 8, and the remainder 6.76, or 7 nearly, which is the Epact for September.

The Epacts, or Numbers for each Month, are as follow:

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In common years ..... | 0 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 7 | 7 | 9 | 9 |
| In leap years..... | 0 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 8 | 10 | 10 |

## OF THE MOON'S AGE.

The moon's age is the number of days that has elapsed since the last change, or the new moon, and never exceeds 30.

### *To find the Moon's Age.*

RULE. To the Epact of the Year add the Number for the Month, and the day of the month: the sum, if it does not exceed 30, is the moon's age; but if it does, subtract 30 from it, and the remainder will be the moon's age.

EXAMPLE. Required the moon's age on July 4th, 1840.

```
19 ) 1840 ( 96
     171
     ---
     130
     114
     ---
      16
      11
     ---
30 ) 176 (5
     150
     ---
The Epact for 1840 = 26
     ---
```

| | |
|---|---|
| Epact for 1840 ..... | 26 |
| Number for the month..... | 5 |
| Day of the month..... | 4 |
| | --- |
| | 35 |
| | 30 |
| | --- |
| The moon's age ..... | 5 Days |
| | --- |

## ON THE MOON'S PASSAGE OVER THE MERIDIAN.

The moon passes the meridian of any place about 48 minutes, or four-fifths of an hour, later every day: now as the moon comes to the meridian with the sun on the day of new moon, the time that she comes to the meridian after the sun, on any day of her age, is easily found as follows:

### *To find the Time of the Moon's Passage over the Meridian.*

RULE. Multiply the moon's age by 4, and divide the product by 5; the quotient will be the hours, and the remainder, multiplied by 12, the minutes, past noon that the moon comes to the meridian. Or multiply the moon's age by 8, and point off the right-hand figure; then the left-hand figure or figures will be the hours, and the product of the right-hand figure by 6, the minutes, past noon of the moon's meridian passage. If the hours exceed 12, subtract that time from them, and the remainder will be the time of the moon's passage over the meridian after midnight.

EXAMPLE I. Required the time of the moon's meridian passage, July 3d, 1838.

| | | | |
|---|---|---|---|
| Epact for 1838 | 4 | Moon's age | 11 Days |
| Number for the month | 4 | | 4 |
| Day of the month | 3 | | 5) 44 |
| Moon's age | 11 Days | | 8 4 |
| | | | 12 |
| | | Moon's passage over meridian | 8h. 48m. P.M. |

EXAMPLE II. At what time will the moon pass the meridian, October 22d, 1840?

| | | | |
|---|---|---|---|
| Epact for 1840 | 26 | Moon's age | 26 Days |
| Number for the month | 8 | | 8 |
| Day of the month | 22 | | 20. 8 |
| | 56 | | 6 |
| | 30 | Moon passes meridian | 20h. 48m. P.M. |
| Moon's age | 26 Days. | | 12 0 |
| | | Or | 8h. 48m. A.M. |

### *To find the Time of High Water at any Place on any given Day of the Moon's Age.*

RULE. To the time of the moon's meridian passage on the given day, add the time of high water at the given place on the full and change days (taken from Table LIII.); their sum is the time of high water at the place, past noon, on the given day. If this sum exceed 12 hours 24 minutes, which is about the interval between each succeeding tide, subtract 12 hours 24 minutes from it; or if it exceed 24 hours 48 minutes, subtract 24 hours 48 minutes from it, and the remainder will be the time of high water in the afternoon of the given day.*

* It is to be observed that the above method gives the times of high water in *solar* or *apparent* time, to which therefore the equation of time (taken from Page I. of the Month in the Nautical Almanac), should be applied, to reduce them to *mean time*.—See Page 153.

EXAMPLE I. Required the time of high water at London, June 10th, 1848.

| | | | |
|---|---|---|---|
| Epact for 1848..... | 25 | Moon's age June 10th, 1848 ... | 9 Days |
| Number for June..... | 4 | | 4 |
| Day of the month ..... | 10 | | |
| | — | | 5) 36 (1 |
| | 39 | | |
| | 30 | Moon's meridian passage ..... | 7h. 12m. |
| | — | Time at London (Table LIII.) | 2 7 |
| Moon's age ..... | 9 Days | | |
| | — | High water at London ..... | 9 19 P.M. |

EXAMPLE II. At what time will it be high water in the Downs, September 25th, 1847?

| | | | |
|---|---|---|---|
| Epact for 1847..... | 14 | Moon's age Sept. 25th, 1847 ... | 16 Days |
| Number for September ..... | 7 | | 8 |
| Day of the month ..... | 25 | | |
| | — | Moon's meridian passage ... | 12h. 48m. |
| | 46 | Time at Downs (Table LIII.) | 11 15 |
| | 30 | | |
| | — | | 24 3 |
| Moon's age ..... | 16 Days | Subtract the time of a tide = | 12 24 |
| | — | | |
| | | High water in the Downs ... | 11 39 P.M. |

The preceding method of finding the time of high water, which is that usually practised at sea, is founded on the supposition that the interval between the moon's passing the meridian, and the time of high water, is always the same; but we have already observed, in the theory of the tides, that the sun brings on the tides sooner in the first and third quarters of the moon, and later in the second and fourth quarters, than if they were produced by the influence of the moon only: hence it will be subject to an error on this account; besides which, the moon's age, as above found, will frequently be more than a day, and the moon's meridian passage above an hour, wide of the truth. We have therefore given a more correct method, with the aid of the Nautical Almanac, in which the moon's position with regard to the sun, her distance from the earth, the longitude of the place, and other particulars, are taken into account. The result of this method will seldom deviate many minutes from the truth, unless when the tides are greatly influenced by the winds.

## METHOD II.

RULE. Find the time of the moon's meridian passage, in *mean time*, on the given day, in Page IV. of the month in the Nautical Almanac, and reduce it to the time of her passing the meridian of the given place by Table XVI.; with this time, corrected by the equation of time to the nearest minute, taken from Page II. of the month in the Nautical Almanac, by addition or subtraction, as directed at the top of the column, and the moon's semidiameter from Page III. of the Nautical Almanac, take out the corresponding correction from Table XVI*, which add to, or subtract from, the above time, as directed in the Table; to the sum or remainder add the time of high water at the given place on full and change days

(Table LIII.), and the sum will be the time of high water, in *mean time*, past noon of the given day. But if the sum exceed 12h. 24m. or 24h. 48m., subtract those times from it, and the remainder will be the time of high water nearly, in the afternoon of the given day.

But should greater accuracy be required, proceed thus:

If the above sum be more than 12 hours, and less than 24 hours, the time of high water found as above, will be that on the following morning; in this case, therefore, to find it for the afternoon of the given day, diminish the moon's passage over the meridian of the ship by half the difference of the passages on the given and preceding days; then proceed as before, rejecting 12 hours from the result. Again, if the above sum be greater than 24 hours, it will be the time of high water after noon of the following day; when this is the case, diminish the moon's passage over the meridian of the ship, by the whole difference between the passages on the given and preceding days, and proceed as before, rejecting 24 hours from the result.

When the time of high water is found for the afternoon of the given day, the time of high water on the preceding morning may be found by subtracting 24 minutes from it; or, on the following morning, by adding 24 minutes to it.

EXAMPLE I. Required the time of high water, in mean time, at Falmouth, on October 27th, 1835.

| | h. | m. | |
|---|---|---|---|
| Moon's meridian passage, in mean time, by Page IV. Nautical Almanac | 5 | 15 | |
| Correction for 5h. 15m. + Eq. of time 16m. = 5h. 31m., and moon's semi-diameter 16′ 0″ (Table XVI*.) | −1 | 12 | |
| | 4 | 3 | |
| Time of high water at Falmouth, full and change days (Table LIII.)... | 5 | 30 | |
| Time of high water at Falmouth, in mean time, October 27th, 1835. ... | 9 | 33 | P.M. |

EXAMPLE II. Required the time of high water, in mean time, at Calcutta, in longitude 88° 27′ E., on January 12th, 1835.

| | h. | m. | |
|---|---|---|---|
| Moon's meridian passage, in mean time, at Greenwich, January 12th, by Page IV. Nautical Almanac | 10 | 28 | |
| Correction to daily variation 52m., and long. 88° 27′ E. (Table XVI.)... | — | 13 | |
| Moon's meridian passage, in mean time, at Calcutta | 10 | 15 | |
| Correction to 10h. 15m. − Eq. of time 9m. = 10h. 6m., and moon's semi-diameter at midnight 15′ 15″ (Table XVI.*) | + | 20 | |
| | 10 | 35 | |
| Time of high water at Calcutta, full and change days (Table LIII.) ... | 3 | 5 | |
| | 13 | 40 | |
| Average time of a tide | 12 | 24 | |
| Time of high water at Calcutta, in mean time, January 12th, 1835... | 1 | 16 | P.M. |
| | | 24 | |
| Time of high water at Calcutta, in mean time, on the following morning | 1 | 40 | A.M. |
| Time of high water at Calcutta, in mean time, on the preceding morning | 0 | 52 | A.M. |

EXAMPLE III. Required the time of high water, in mean time, at Halifax, in longitude 63° 34′ W., on August 19th, 1835.

| | h. | m. | |
|---|---|---|---|
| Moon's meridian passage, in mean time, at Greenwich, August 19th, by Page IV. in Nautical Almanac | 20 | 55 | |
| Correction to daily variation 54m., and long. 63° 34′ W. (Table XVI.) | + | 9 | |
| Time of moon's meridian passage, in mean time, at Halifax | 21 | 4 | |
| Correction to 21h. 4m.—Eq. of time 3m.=21h. 1m., and moon's semi-diameter at noon on 20th, 15′ 7″ (Table XVI*.) | + | 19 | |
| | 21 | 23 | |
| Time of high water at Halifax, full and change days (Table LIII.) | 8 | 0 | |
| | 29 | 23 | |
| Average time of two tides | 24 | 48 | |
| Time of high water at Halifax, in mean time, August 19th, 1835 | 4 | 35 | P.M. |

The last two Examples may be worked more correctly as follow:

EXAMPLE II. Required the time of high water, in mean time, at Calcutta, in longitude 88° 27′ E., on January 12th, 1835.

| | h. | m. | |
|---|---|---|---|
| Moon's meridian passage, in mean time, at Calcutta, (as before) | 10 | 15 | |
| Half the differences of passages (52m.) on the given and preceding days | — | 26 | |
| | 9 | 49 | |
| Correction to 9h. 49m.—Eq. of time 9m.=9h. 40m., and moon's semi-diameter 15′ 15″ (Table XVI.*) | + | 22 | |
| | 10 | 11 | |
| Time of high water at Calcutta, full and change days (Table LIII.) | 3 | 5 | |
| | 13 | 16 | |
| Subtract | 12 | | |
| Time of high water at Calcutta, mean time, January 12th, 1835 | 1 | 16 | P.M. |

EXAMPLE III. Required the time of high water, in mean time, at Halifax, in longitude 63° 34′ W., on August 19th, 1835.

| | h. | m. | |
|---|---|---|---|
| Moon's meridian passage, in mean time, at Halifax (as before) | 21 | 4 | |
| Differences of passages on the given and preceding days | — | 52 | |
| Moon's meridian passage, mean time, at Halifax, August 18th | 20 | 12 | |
| Correction to 20h. 12m.—Eq. of time 4m.=20h. 8m., and moon's semidiameter at noon, August 19th, 14′ 58″ (Table XVI*.) | + | 4 | |
| | 20 | 16 | |
| Time of high water at Halifax, full and change days (Table LIII.) | 8 | 0 | |
| | 28 | 16 | |
| Subtract | 24 | 0 | |
| Time of high water at Halifax, mean time, August 19th, 1835 | 4 | 16 | P.M. |

NOTE. In pages 496, 497 of the Nautical Almanac for 1835, the mean times of high water at London Bridge are given for every day throughout that year, and will serve to find the same at any place on the Coasts of Great Britain, Ireland, or other parts near the meridian of Greenwich, as explained in page 540 of that Work.

## EXAMPLES FOR EXERCISE.

Required the times of high water at the following places and times.

1. At Botany Bay, in longitude 151° 16′ E., on 23d November, 1835.
   *Ans.* By first method, 10h. 24m. P.M.; by last method, 9h. 43m. P.M.
2. At Boston, in longitude 71° 4′ W., on 9th April, 1835.
   *Ans.* By first method, 7h. 49m. P.M.; by last method, 8h. 51m. P.M.
3. At Calcutta, in longitude 88° 27′ E., on 16th September, 1835.
   *Ans.* By first method, 9h. 57m. P.M.; by last method, 9h. 30m. P.M.
4. At Bombay, in longitude 72° 54′ E., on 12th December, 1835.
   *Ans.* By first method, 3h. 58m. P.M.; by last method, 3h. 18m. P.M.
5. At New York, in longitude 74° 3′ W., on 20th July, 1835.
   *Ans.* By first method, 4h. 6m. P.M.; by last method, 4h. 44m. P.M
6. At Rio Janeiro, in longitude 43° 16′ W., on 3d July, 1835.
   *Ans.* By first method, 9h. 4m. P.M.; by last method, 7h. 55m. P.M.
7. At Trincomalé, in longitude 81° 21′ E., on 26th January, 1835.
   *Ans.* By first method, 2h. 48m. P.M.; by last method, 4h. 17m. P.M.
8. At Quebec, in longitude 71° 10′ W., on 28th June, 1835.
   *Ans.* By first method, 8h. 21m. P.M.; by last method, 8h. 24m. P.M.

### *To find the Time of High Water at a given Place on the full and change Days of the Moon, when the Time of High Water is known at that Place on any other Day.*

Rule. Reduce the time of the moon's meridian passage at Greenwich in *mean time*, found in Page IV. of the month in the Nautical Almanac, to the time of her passing over the meridian of the given place, by Table XVI; to this time, corrected by the equation of time to the nearest minute, taken from Page II. of the month in the Nautical Almanac, by addition or subtraction, as directed at the top of the column, apply the correction from Table XVI*, and subtract the result from the observed time of high water in mean time on the given day: the remainder will be the time of high water at the given place, on full and change days.

But should the time to be subtracted, be greater than the observed time of high water, from the time of the moon's meridian passage over the given place, subtract half the difference of two successive passages, and then proceed as before, adding 12 hours to the observed time of high water. Again, should the time to be subtracted, be still the greater, take the whole difference of two successive passages from the time of the moon's passing the meridian of the place, and proceed as before, adding 24 hours to the observed time of high water.

Example I. Suppose that in the harbour of Rio Janeiro, in longitude 43° 16′ W., on the 3d of July, 1835, the time of high water should be at 7h. 55m. P.M., required the time of high water on the full and change days of the moon.

| | h. | m. | |
|---|---|---|---|
| Moon's meridian passage, in mean time, at Greenwich, July 3d, by Page IV. of Nautical Almanac | 6 | 10 | |
| Correction to daily variation 49m. and long. 48° 16′ W. (Table XVI.) | + | 6 | |
| Moon's meridian passage, in mean time, at Rio Janeiro | 6 | 16 | |
| Correction to 6h. 16m.—Eq. of time 4m.=6h. 12m. and moon's semi-diameter 16′ 0″ (Table XVI.*) | − | 1 | 1 |
| | 5 | 15 | |
| Observed time of high water, in mean time | 7 | 55 | |
| Time of high water, at Rio Janeiro, on full and change days | 2 | 40 | P.M. |

Example II. Suppose that in the harbour of New York, in longitude 74° 3′ W., on the 13th February, 1835, the time of high water should be at 9h. 26m. P.M., required the time of high water on the full and change days.

| | h. | m. | |
|---|---|---|---|
| Moon's meridian passage, in mean time, at Greenwich, February 13th, by Page IV. of Nautical Almanac | 12 | 51 | |
| Correction to daily variation 52m., and long. 74° 3′ W. (Table XVI.) | + | 10 | |
| Moon's meridian passage in mean time at New York | 13 | 1 | |
| Half the difference (52m.) of passages, on given and following days | − | 26 | |
| | 12 | 35 | |
| Correction to 12h. 35m.—Eq. of time 15m.=12h. 20m. and moon's semidiameter, at midnight, 16′ 6″ (Table XVI*) | − | 3 | |
| | 12 | 32 | |
| Observed time, of high water, in mean time, +12 hours | 21 | 26 | |
| Time of high water, at New York, on full and change days | 8 | 54 | P.M. |

# HADLEY'S QUADRANT.

It is generally allowed that we are indebted to John Hadley, Esq. for the invention, or at least the first public account, of that admirable instrument, commonly called Hadley's Quadrant, who, in the year 1731, first communicated its principles to the Royal Society, which were by them published soon after in their Philosophical Transactions. Before this period the Cross Staff, and Davis's Quadrant, were the only instruments used for measuring altitudes at sea; both very imperfect, and liable to considerable error in rough weather: the superior excellence, however, of Hadley's Quadrant, soon obtained its general use among seamen; and the many improvements this instrument has received from ingenious men at various times, have rendered it so correct, that it is now applied, with the greatest success, to

the important purposes of ascertaining both the latitude and longitude at sea.

Figure 1, Plate VIII. is a representation of Hadley's Quadrant; the principal parts of which are, the Octant, or Frame A B C; the Arch, or Limb B C; the Index D; the Nonius, or Vernier Scale, E; the Index Glass F; the Fore Horizon Glass G; the Back Horizon Glass H; the Shades, or Dark Glasses, I; and the Sight Vanes K and L.

The OCTANT, or FRAME, is generally made of ebony, or other hard wood, and consists of an arch firmly attached to two radii or bars A B, A C, which are strengthened and bound by the two braces M and N, in order to prevent it from warping.

The ARCH or LIMB, although only the eighth part of a circle, is, on account of the double reflection, divided into 90 degrees, numbered 0, 10, 20, 30, &c. from right towards the left; these are subdivided into 3 parts, containing each 20 minutes, which are again subdivided into single minutes, by means of the scale at the end of the Index. The arch extending from 0 towards the right-hand, is called the *arch of excess*.

The INDEX is a flat brass bar, that turns on the centre of the instrument. At the lower end of the index there is an oblong opening. To one side of this opening a nonius scale is fixed, to subdivide the divisions of the arch. At the bottom, or end of the index, there is a piece of brass which bends under the arch, carrying a spring, to make the nonius scale lie close to the divisions; it is also furnished with a screw, to fix the index in any desired position.

Some instruments have an *adjusting* or *tangent-screw* fitted to the index, that it may be moved more slowly, and with greater regularity and accuracy than by the hand: it is proper, however, to observe, that the index must be previously fixed near its right position by the above-mentioned screw, before the adjusting screw is put in motion.

The NONIUS is a scale fixed to the end of the index, for the purpose, as before observed, of dividing the subdivisions on the arch into minutes. It sometimes contains a space of 7 degrees, or 21 subdivisions of the limb, and is divided into 20 equal parts; hence each division on the nonius will be one-twentieth part greater, that is, one minute longer than the divisions on the arch; consequently, if the first division of the nonius, marked 0, be set precisely opposite to any degree, the relative position of the nonius and the arch must be altered one minute before the next division on the nonius will coincide with the next division on the arch. The second division will require a change of two minutes; the third of three minutes; and so on, till the 20th stroke on the nonius arrives at the next 20 minutes on the arch; the 0 on the nonius will then have moved exactly 20 minutes from the division whence it set out, and the intermediate divisions of each minute have been regularly pointed out by the divisions of the nonius.

The divisions of the nonius scale are in the above case reckoned from the middle towards the right, and from the left towards the middle; therefore the first 10 minutes are contained on the right of the 0, and the other 10 on the left. But this method of reckoning the divisions being found inconvenient, they are more generally counted, beginning from the right-hand

towards the left; and then 20 divisions on the nonius are equal to 19 on the limb: consequently one division on the arch will exceed one on the nonius by one-twentieth part, that is, one minute.

The 0 on the nonius points out the entire degrees and odd twenty minutes subtended by the objects observed; and if it coincide with a division on the arch, points out the required angle: thus, suppose the 0 on the nonius stands at 25 degrees, then 25 degrees will be the measure of the angle observed; if it coincides with the next division on the left-hand, 25 degrees 20 minutes is the angle; if with the second division beyond 25 degrees, then the angle will be 25 degrees 40 minutes; and so on in every instance where the 0 on the nonius coincides with a division on the arch; but if it do not coincide, then look for a division on the nonius that stands directly opposite to one on the arch, and that division on the nonius gives the odd minutes to be added to that on the arch nearest the right-hand of the 0 on the nonius: for example—suppose the index division does not coincide with 25 degrees, but that the next division to it on the nonius is the first coincident division, then is the required angle 25 degrees 1 minute; if it had been the second division, the angle would have been 25 degrees 2 minutes, and so on to 20 minutes, when the 0 on the nonius would coincide with the first 20 minutes on the arch from 25 degrees. Again, let us suppose the 0 on the nonius to stand between 50 degrees and 50 degrees 20 minutes, and that the 15th division on the nonius coincides with a division on the arch, then is the angle 50 degrees 15 minutes. Further, let the 0 on the nonius stand between 45 degrees 20 minutes and 45 degrees 40 minutes, and at the same time the 14th division on the nonius stands directly opposite to a division on the arch, then will the angle be 45 degrees 34 minutes.

The INDEX GLASS is a plane speculum, or mirror of glass quick-silvered, set in a brass frame, and so placed that the face of it is perpendicular to the plane of the instrument, and immediately over the centre of motion of the index. This mirror being fixed to the index, moves along with it, and has its direction changed by the motion thereof.

This glass is designed to reflect the image of the sun, or any other object, upon either of the two horizon glasses, from whence it is reflected to the eye of the observer. The brass frame, with the glass, is fixed to the index by two screws at the back; the other screw s serves to place it in a perpendicular position, if by any accident it has been put out of order.

The HORIZON GLASSES are two small speculums on the radius A B of the frame; the surface of the upper one is parallel to the index-glass when the 0 on the nonius is at 0 on the arch; these mirrors receive the rays of the object reflected from the index-glass, and transmit them to the observer. The fore horizon-glass G is only silvered on its lower half, the upper half being transparent, in order that the direct object may be seen through it. The back horizon-glass H is silvered at both ends; in the middle there is a transparent slit, through which the horizon may be seen. Each of these glasses is set in a brass frame, to which there is an axis; this axis passes through the wood work, and is fitted to a lever on the under side of the quadrant, by which the glass may be turned a few degrees on its axis, in

order to set the face of the fore horizon-glass parallel, or that of the back horizon-glass at right angles, to the index-glass.

To set the glasses perpendicular to the plane of the quadrant, there are two sunk screws, one before and one behind each glass: these screws pass through the plate on which the frame is fixed into another plate, so that by loosening one, and tightening the other of these screws, the direction of the frame, with its mirror, may be altered, and thus be set perpendicular to the plane of the instrument.

The DARK GLASSES, or SHADES, are used to prevent the bright rays of the sun, or glare of the moon, from hurting the eye at the time of observation. There are generally three of them, two red, and one green. They are each set in a brass frame which turns on a centre, so that they may be used separately or together, as the brightness of the object may require. The green glass may be used also alone, if the sun be very faint: it is likewise used in taking observations of the moon. When these glasses are used for the fore observation, they are fixed at 1, as in Figure 1, but for the back observation, they are removed to 0.

The SIGHT VANES are pieces of brass, standing perpendicular to the plane of the instrument: that one which is opposite the fore horizon, is called *the fore sight vane*, the other *the back sight vane*. There are two holes in the fore sight vane, the lower of which, and the upper edge of the silvered part of the fore horizon-glass, are equidistant from the plane of the instrument, and the other is opposite to the middle of the transparent part of that glass; the back sight vane has only one hole, which is exactly opposite to the middle of the transparent slit in the horizon-glass to which it belongs.

## ADJUSTMENTS OF HADLEY'S QUADRANT.

The several parts of the Quadrant being liable to be out of order, from a variety of accidental circumstances, it is necessary to examine and adjust them, so that the instrument may be put into a proper state previous to taking observations.

An instrument properly adjusted, must have the index-glass and horizon-glasses perpendicular to the plane of the Quadrant; the plane of the fore horizon-glass parallel, and that of the back horizon-glass perpendicular to the plane of the index-glass, when the 0 on the nonius is at 0 on the arch: hence the Quadrant requires five adjustments, the first three of which being once made, are not so liable as the last two to be out of order: however, they should all be occasionally examined, in case of accident.

### I. *To set the Plane of the Index-Glass perpendicular to that of the Instrument.*

Place the index near to the middle of the arch, and holding the Quadrant in a horizontal position, with the index-glass close to the eye, look obliquely down the glass, in such a manner that you may see the arch of the Quadrant by direct view, and by reflection at the same time; if they join in one direct

line, and the arch seen by reflection forms an exact plane, or strait line, with the arch seen by direct view, the glass is perpendicular to the plane of the Quadrant; if not, it must be restored to its right position by loosening the two sunken screws, and tightening the screw s, or *vice versâ*, by tightening the sunken screws, and releasing the screw s.

### II. *To set the Fore Horizon-Glass parallel to the Index-Glass, the Index being at* 0.

Set the 0 on the nonius exactly against 0 on the arch, and fix it there by the screw at the under side. Then, holding the Quadrant vertically, with the arch lowermost, look through the sight-vane K, at the edge of the sea, or any other well-defined and distant object. Now, if the horizon in the silvered part exactly meet, and form one continued line with that seen through the unsilvered part, the horizon-glass is parallel to the index-glass. But if the horizons do not coincide, then loosen the button-screw in the middle of the lever, on the under side of the Quadrant, and move the horizon-glass on its axis, by turning the nut at the end of the adjusting lever, till you have made them perfectly coincide; then fix the lever firmly in this situation by tightening the button-screw. This adjustment ought to be repeated before and after every observation. Some observers adopt the following method, which is called finding the *index error*:—Let the horizon-glass remain fixed, and move the index till the image and object coincide; then observe whether 0 on the nonius agree with 0 on the arch; if it do not, the number of minutes by which they differ, is to be added to the observed altitude or angle, if the 0 on the nonius be to the right of the 0 on the arch; but if to the left of the 0 on the limb, it is to be subtracted.

It has already been observed, that that part of the arch beyond 0, towards the right hand, is called the arch of excess: the nonius, when the 0 on it is at that part, must be read the contrary way; or, which is the same thing, you may read off the minutes in the usual way, and then their complement to 20 minutes will be the real number, to be added to the degrees and minutes pointed out by the 0 on the nonius.

### III. *To set the Fore Horizon-Glass perpendicular to the Plane of the Quadrant.*

Having previously made the above adjustment, incline the Quadrant on one side as much as possible, provided the horizon continues to be seen in both parts of the glass. If, when the instrument is thus inclined, the edge of the sea, seen through the lower hole of the sight-vane, continue to form one unbroken line, the horizon-glass is perfectly adjusted; but if the reflected horizon be separated from that seen by direct vision, the speculum is not perpendicular to the plane of the Quadrant: then if the limb of the Quadrant be inclined towards the horizon, with the face of the instrument upwards, and the reflected sea appear higher than the real sea, you must slacken the screw before the horizon-glass, and tighten that which is behind it; but if the reflected sea appear lower, the contrary must be performed. Care must be always taken in this adjustment, to loosen one screw before the other is

screwed up, and to leave the adjusting screws tight, or so as to draw with a moderate force against each other.

This adjustment may be also made by the sun, moon, or a star: in this case the Quadrant is to be held in a vertical position; if the image seen by reflection, appear to the right or left of the object seen directly, then the glass must be adjusted, as before, by the two screws. This will be further explained in the use of the Sextant.

Some Quadrants have a vertical screw at the back of the instrument, by which the adjustment is made.

It will be necessary, after having made this adjustment, to examine if the horizon-glass still continue to be parallel to the index-glass; as sometimes, by turning the sunken screws, the plane of the horizon-glass will have its position altered.

### IV. *To set the Back Horizon-Glass perpendicular to the Plane of the Index-Glass,* 0 *on the Nonius being at* 0 *on the Arch.*

Let the 0 on the nonius be put as much to the right of 0 on the arch as twice the dip (taken from Table V.) amounts to: hold the Quadrant in a vertical position, and apply the eye to the back sight-vane L; then if the reflected horizon, which will appear inverted, or upside down, coincide with that seen direct, the glass is adjusted; otherwise the screw in the middle of the lever, on the under side of the Quadrant, must be slackened, and the nut at its extremity turned till both horizons coincide.

### V. *To set the Back Horizon-Glass perpendicular to the Plane of the Quadrant.*

This adjustment is performed by holding the Quadrant nearly parallel to the horizon, and directing the sight through the back sight-vane; then, if the true and reflected horizons appear in the same strait line, the glass is perpendicular to the plane of the instrument; but if they do not coincide, turn the sunken screws in the pedestal of the glass, till both appear to form one strait line.

## USE OF HADLEY'S QUADRANT.

The use of the Quadrant is to ascertain the angle subtended by two distant objects at the eye of the observer; but principally to observe the altitude of a celestial object above the horizon: this is pointed out by the index, when one of the objects seen by reflection, is made to coincide with the other, seen through the transparent part of the horizon-glass.

There are two different methods of observing altitudes with a Quadrant: one is when the observer's face is directed towards the celestial body, and it is brought down by reflection to that part of the horizon immediately under it; the altitude is in this case said to be taken by a *fore observation*: the other method is when the observer's back is towards the object, and it is brought over to the opposite part of the horizon, and is thence called a *back observation*. This latter method of observing is very seldom used, and is requisite only when the horizon under the object is broken by adjacent shores, or rendered indistinct by fogs, or any other impediments.

### *To take an Altitude of the Sun, Moon, or a Star, by a Fore Observation.*

Having previously adjusted the instrument, place the 0 on the nonius opposite to 0 on the arch, and turn down one or more of the screens, according to the brightness of the sun; then apply the eye to the upper hole in the fore sight-vane, if the sun's image be very bright, otherwise to the lower, and holding the Quadrant vertically, look directly towards the sun, so as to let it be behind the silvered part of the horizon-glass, then the coloured sun's image will appear on the speculum. Move the index forwards till the sun's image, which will appear to descend, just touch the horizon with its lower or upper limb. If the upper hole be looked through, the sun's image must be made to appear in the middle of the transparent part of the horizon-glass; but if the lower hole, hold the Quadrant so that the sun's image may be bisected by the line joining the silvered and transparent parts of the horizon-glass.

The sun's limb ought to touch that part of the horizon immediately under the sun; but as this point cannot be exactly ascertained, it will therefore be necessary for the observer to give the Quadrant a slow motion from side to side, turning at the same time upon his heel, by which motion the sun will appear to sweep the horizon, and must be made just to touch it at the lowest part of the arch: the degrees and minutes then pointed out by the index on the limb of the Quadrant, will be the observed altitude of that limb which is brought in contact with the horizon.

In this manner the altitude of the moon, or a star, may be taken by a fore observation, remembering that when the moon is the object, her enlightened side is to be brought to the horizon, whether it be the upper or lower limb.

When the meridian, or greatest altitude, is required, the observation should be commenced a short time before the object comes to the meridian. Being brought down to the horizon, it will appear for a few minutes to rise slowly, when it is again to be made to coincide with the horizon, by moving the index forward: this must be repeated until the object begin to descend, when the index is to be secured, and the observation to be read off.

Note. For the methods of finding the time of the moon's, or a star's, passing the meridian, see the Explanation to Tables XVI, XLIII, and XLIV.

### *To take an Altitude of the Sun, Moon, or a Star, by a Back Observation.*

Place the dark glasses in the hole near the back horizon-glass, and turn one or more of them down, according to the brightness of the sun; then, looking through the back sight-vane towards that part of the horizon opposite the sun, the Quadrant being held vertically, move the index till the sun's image be seen on the silvered part of the glass, and giving the Quadrant a slow vibratory motion, the sun will appear to describe an arch with its convex side upwards. Bring one of the limbs in contact with that part of the horizon seen through the transparent slit when it is in the upper part of this arch, and the degrees and minutes pointed out by the index, will be the altitude of the other limb; for in the back observation the image of the object is inverted. In the same manner, the altitude of the moon, or a star, may be taken, observing to bring the enlightened limb of the moon in contact with the horizon

ON FINDING THE

# LATITUDE BY OBSERVATION.

THE latitude of a place is its distance from the equator, either north or south, and is measured by an arch of a meridian contained between the zenith and the equinoctial: hence, if the distance of any heavenly body from the zenith when on the meridian, and its declination, or number of degrees and minutes it is to the northward or southward of the equinoctial, be given, the latitude may thence be found.

The meridian zenith distance of an object is found either from its altitude taken when on the meridian, or from one or two altitudes observed when out of the meridian.

Altitudes of the sun or moon taken at sea require four corrections, in order to obtain the true altitude of their centre: these are for semidiameter, dip, refraction, and parallax*. When the altitude of a star is observed, the corrections for dip and refraction only are to be applied. The parallax of the sun or a planet being but a few seconds, is seldom noticed in finding the latitude at sea.

*To find the Latitude of a Place by the Meridian Altitude of the Sun.*

RULE. From the observed altitude of the sun's limb (corrected for index error, if any), subtract the dip answering to the height of the eye above the horizon (found in Table V.), when the altitude is taken by a fore observation, or add it in a back observation, and the result will be the apparent altitude of the observed limb; from which subtract the refraction corresponding to that altitude (taken from Table IV.), and the remainder will be the true altitude of the observed limb.

When the sun's lower limb is observed, add the sun's semidiameter (16 minutes), but if the upper limb be observed, subtract it; and the sum, or remainder, will be the true altitude of the sun's centre†: or, when the altitude of the sun's lower limb is observed by a fore observation, the correction for the joint effect of the semidiameter, dip, refraction, and parallax, may be taken at once from Table IX.

Subtract the true altitude of the sun's centre from 90°, and the remainder will be the sun's true meridian zenith distance, which is to be called north or south, according as the observer, or his zenith, is north or south of the sun at the time of observation.

Take the sun's declination from Table X., and reduce it to the meridian of the ship (when the longitude is considerable) by Table XI., noting whether it be north or south: then if the zenith distance, and declination, be both north, or both south, add them together; but if one be north, and the other south, subtract the less from the greater, and the sum, or difference, will be the latitude, of the same name with the greater.

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* For an explanation of these corrections, see page 149, &c.

† Many seamen add 11 or 12 minutes to the observed altitude of the lower limb (being the difference between the semidiameter and the dip), and omit the correction for refraction altogether; but this neglect will frequently produce an error of several miles in the latitude, especially when the meridian altitude is small.

NOTE. If it be required to work the observation to seconds, the sun's semidiameter is to be taken from Page II. of the month in the Nautical Almanac; the declination for apparent noon at Greenwich, from Page I. of the same; and the latter reduced to noon at the meridian of the ship by Table XXI†. Take also the sun's correction in altitude, which is the difference of his refraction and parallax, from Table XVIII., instead of the refraction only, as shewn in Table IV. When the horizon under the sun is obstructed by land, the dip is to be taken from Table VIII.

### EXAMPLE I.

June 18, 1835, the meridian altitude of the sun's lower limb was 43° 18′, the observer being North of the sun, and his eye elevated 18 feet above the surface of the sea: required the latitude of the place of observation, to the nearest minute.

| | ° | ′ | |
|---|---|---|---|
| Obs. alt. of sun's lower limb ..... | 43 | 18 | |
| Dip of the horizon (Table V.) ... | − | 4 | |
| App. alt. sun's lower limb ..... | 43 | 14 | |
| Refraction (Table IV.) ..... | − | 1 | |
| True alt. sun's lower limb ..... | 43 | 13 | |
| Sun's semidiameter ..... | + | 16 | |
| True alt. sun's centre ..... | 43 | 29 | |
| | 90 | | |
| Sun's true zenith distance ..... | 46 | 31 | N. |
| Sun's declination (Table X.) ..... | 23 | 25 | N. |
| Latitude..... | 69 | 56 | N. |

### EXAMPLE II.

September 21, 1837, in longitude 60° E., the meridian altitude of the sun's lower limb was 56° 26′, the observer being South of the sun, and the height of his eye 26 feet: required the latitude to the nearest minute.

| | ° | ′ | |
|---|---|---|---|
| Obs. alt. sun's lower limb ..... | 56 | 26 | |
| Dip of the horizon (Table V.) ... | − | 5 | |
| App. alt. sun's lower limb..... | 56 | 21 | |
| Refraction (Table IV.) ..... | − | 1 | |
| True alt. sun's lower limb..... | 56 | 20 | |
| Sun's semidiameter..... | + | 16 | |
| True alt. sun's centre ..... | 56 | 36 | |
| | 90 | | |
| Sun's true zenith distance..... | 33 | 24 | S. |
| Sun's declination (Tab. X.) 0° 42′ | 0 | 46 | N. |
| Corr. for long. (Table XI.) + 4 | | | |
| Latitude ..... | 32 | 38 | S. |

### EXAMPLE III.

January 9, 1836, in longitude 116° W., the meridian altitude of the sun's upper limb was 69° 14′ South, the observer being about 3 miles from the land, under the sun, and his eye elevated 22 feet: required the latitude to the nearest minute.

| | ° | ′ | |
|---|---|---|---|
| Obs. alt. sun's upper limb ..... | 69 | 14 | |
| Dip of the horizon (Table VIII.).. | − | 5 | |
| App. alt. sun's upper limb ..... | 69 | 9 | |
| Refraction ..... | − | 0 | |
| True alt. sun's upper limb ..... | 69 | 9 | |
| Sun's semidiameter ..... | − | 16 | |
| True alt. sun's centre ..... | 68 | 53 | S. |
| | 90 | | |
| Sun's true zenith distance ..... | 21 | 7 | N. |
| Sun's declin. (Tab. X.)... 22° 12′ | 22 | 9 | S. |
| Corr. for long. (Table XI.) − 3 | | | |
| Latitude..... | 1 | 2 | S. |

### EXAMPLE IV.

December 25, 1840, in longitude 35° W., the meridian altitude of the sun's lower limb, by a back observation, was 16° 28′ South, the height of the eye being 20 feet: required the latitude to the nearest minute.

| | ° | ′ | |
|---|---|---|---|
| Obs. alt. sun's lower limb ..... | 16 | 28 | |
| Dip of the horizon..... | + | 4 | |
| App. alt. sun's lower limb ..... | 16 | 32 | |
| Refraction ..... | − | 3 | |
| True alt. sun's lower limb ..... | 16 | 29 | |
| Sun's semidiameter ..... | + | 16 | |
| True alt. sun's centre ..... | 16 | 45 | S. |
| | 90 | | |
| Sun's true zenith distance..... | 73 | 15 | N. |
| Sun's declin. (Tab. X.)...23° 24′ | 23 | 24 | S. |
| Corr. for long. (Tab. XI.) − 0 | | | |
| Latitude ..... | 49 | 51 | N. |

† Or more correctly by Table XXXIII.—See the Explanation to that Table.

### EXAMPLE V.

May 29, 1835, in longitude 30° W., the meridian altitude of the sun's lower limb was observed to be 65° 42′ 30″, the zenith being North of the sun, and the height of the eye 24 feet: required the latitude.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Sun's declin. by Naut. Alm..... | 21 | 33 | 22 | N. |
| Corr. for long. 30° W. (Tab. XXI.) | + | 0 | 49 | |
| Sun's reduced declination ..... | 21 | 34 | 11 | N. |
| Obs. alt. sun's lower limb. ..... | 65 | 42 | 30 | |
| Dip of the horizon ..... | − | 4 | 42 | |
| App. alt. sun's lower limb ..... | 65 | 37 | 48 | |
| Refraction ..... | − | 0 | 25 | |
| True alt. sun's lower limb ..... | 65 | 37 | 23 | |
| Sun's semidiameter by N. Alm. | + | 15 | 48 | |
| True alt. sun's centre ..... | 65 | 53 | 11 | |
| | 90 | | | |
| Sun's true zenith distance ..... | 24 | 6 | 49 | N. |
| Sun's reduced declination ..... | 21 | 34 | 11 | N. |
| Latitude..... | 45 | 41 | 0 | N. |

### EXAMPLE VI.

November 21, 1835, in longitude 165° E., the meridian altitude of the sun's lower limb was observed to be 47° 36′ 45″ S., the height of the eye being 18 feet: required the latitude.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Sun's declin. by Naut. Alm.... | 19 | 50 | 34 | S. |
| Corr. for long. 165° E. (Tab. XXI.) | − | 5 | 52 | |
| Sun's reduced declination ..... | 19 | 44 | 42 | S. |
| Obs. alt. sun's lower limb ..... | 47 | 36 | 45 | S. |
| Dip of the horizon ..... | − | 4 | 4 | |
| App. alt. sun's lower limb..... | 47 | 32 | 41 | |
| Refr.—parallax (Tab. XVIII.) | − | 0 | 46 | |
| True alt. sun's lower limb..... | 47 | 31 | 55 | |
| Sun's semidiameter by N. Alm. | + | 16 | 13 | |
| True alt. sun's centre..... | 47 | 48 | 8 | |
| | 90 | | | |
| Sun's true zenith distance..... | 42 | 11 | 52 | N. |
| Sun's reduced declination ..... | 19 | 44 | 42 | S. |
| Latitude ..... | 22 | 27 | 10 | N. |

### EXAMPLE VII.

August 22, 1835, in longitude 8° West, the meridian altitude of the sun's lower limb was 77° 49′ 30″, the observer being South of the sun, the height of his eye 30 feet, and the index error 1′ 30″ to be added*: required the latitude.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Sun's declin. by Naut. Alm..... | 11 | 57 | 47 | N. |
| Corr. for long. 8° W. (Tab. XXI.) | − | 0 | 27 | |
| Sun's reduced declination ..... | 11 | 57 | 20 | N. |
| Obs. alt. sun's lower limb ..... | 77 | 49 | 30 | |
| Index error to be added ..... | + | 1 | 30 | |
| Corr. obs. alt. sun's lower limb.. | 77 | 51 | 0 | |
| Corr. from Table IX. 10′.2 = | + | 10 | 12 | |
| True alt. sun's centre ..... | 78 | 1 | 12 | |
| | 90 | | | |
| Sun's zenith distance ..... | 11 | 58 | 48 | S. |
| Sun's reduced declination..... | 11 | 57 | 20 | N. |
| Latitude..... | 0 | 1 | 28 | S. |

### EXAMPLE VIII.

October 12, 1835, in longitude 30° E., the meridian altitude of the sun's lower limb was 89° 54′ 30″ from the South point of the horizon, the height of the eye being 12 feet, and the index error 2′ 0″ to be subtracted*: required the latitude.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Sun's declin. by Naut. Alm. ... | 7 | 13 | 56 | S. |
| Corr. for long. 30° E. (Tab. XXI.) | − | 1 | 52 | |
| Sun's reduced declination ..... | 7 | 12 | 4 | S. |
| Obs. alt. sun's lower limb ..... | 89 | 54 | 30 | S. |
| Index error to be subtracted... | − | 2 | 0 | |
| Corr. obs. alt. sun's lower limb | 89 | 52 | 30 | |
| Corr. from Table IX. 12′.7 = | + | 12 | 42 | |
| | 90 | 5 | 12 | |
| | 90 | | | |
| Zenith distance ..... | 0 | 5 | 12 | S. |
| Sun's reduced declination ..... | 7 | 12 | 4 | S. |
| Latitude ..... | 7 | 17 | 16 | S. |

* When the horizon-glass of the Instrument has not been adjusted so as to be parallel to the index-glass when 0 in the nonius is at 0 in the arch, the observed altitude is in all cases to be corrected for the *Index Error*.—See Description and Use of the Quadrant or Sextant.

EXAMPLES FOR EXERCISE.

1. August 30, 1835, in longitude 130° W., the meridian altitude of the sun's lower limb was 57° 18′ 30″, the observer being North of the sun, and the height of his eye 18 feet: required the latitude.

Answer. 41° 33′ 44″ North.

2. December 3, 1835, in longitude 62° E., the meridian altitude of the sun's lower limb was 64° 45′ 15″ North of the observer, the height of his eye being 20 feet: required the latitude.

Answer. 47° 5′ 38″ South.

3. January 15, 1835, in longitude 149° 30′ E., the meridian altitude of the sun's upper limb was 33° 14′ 45″, the observer being North of the sun, the height of his eye 14 feet, and the error of the instrument 2′ 30″ to add: required the latitude.

Answer. 35° 47′ 28″ North.

4. March 21, 1835, in longitude 98° E., the meridian altitude of the sun's lower limb was 89° 42′ 40′ South of the observer, the height of his eye being 12 feet, and the index error 2′ 20″ to add: required the latitude.

Answer. On the equator.

5. September 23, 1835, in longitude 104° W., the meridian altitude of the sun's lower limb was 74° 48′, the zenith being South of the sun, the height of the eye 24 feet, and the instrument adjusted: required the latitude to the nearest minute.

Answer. 15° 1′ South.

6. March 10, 1835, in longitude 26° 30′ E., the meridian altitude of the sun's lower limb was 14° 24′ S., the height of the eye being 25 feet, the distance of the land under the sun 3 miles, and the Quadrant adjusted: required the latitude to the nearest minute.

Answer. 71° 12′ North.

*To find the Latitude by the Meridian Altitude of a Star.**

Rule. Take out the star's declination from Table XIII., and reduce it to the time of observation. From the observed altitude of the star subtract the dip and refraction, taken from Tables V. and IV., or subtract the correction taken from Table XV., and the remainder will be the star's true altitude, which subtracted from 90°, will give the zenith distance: to be called North or South, according as the observer is north or south of the star at the time of observation.

Then, if the zenith distance and declination be both north, or both south, add them together; but if one be north, and the other south, subtract the less from the greater, and the sum, or difference, will be the latitude, of the same name with the greater.

* For the method of finding the time of a star's passing the meridian, see the Explanation to Table XLIII. also the Explanation to Table XLIV., where directions are given for finding what star is on or near the meridian, and for observing its altitude.

### EXAMPLE I.

January 24, 1836, about 8 o'clock in the evening, the meridian altitude of the star Aldebaran was 52° 36′, the observer being North of the star, and the height of his eye 20 feet: required the latitude.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Declin. of Aldebaran, 1834..... | 16 | 10 | 9 | N. |
| Ann. var. + 7″.96 × 2 = | + | 0 | 16 | |
| Dec. of Aldebaran, Jan. 1836... | 16 | 10 | 25 | N. |
| | ° | ′ | | |
| Obs. alt. of Aldebaran ..... | 52 | 36 | | |
| Dip of horizon ..... | — | 4 | | |
| App. alt. of Aldebaran..... | 52 | 32 | | |
| Refraction..... | — | 1 | | |
| True alt. of Aldebaran..... | 52 | 31 | | |
| | 90 | | | |
| Star's zenith distance ..... | 37 | 29 | | N. |
| Star's declination, Jan. 1836 ... | 16 | 10 | | N. |
| Latitude..... | 53 | 39 | | N. |

### EXAMPLE II.

July 16, 1845, about 3 o'clock in the morning, the meridian altitude of the star Fomalhaut was 73° 36′ South of the observer, the height of his eye being 24 feet: required the latitude.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Declin. of Fomalhaut, 1834 ... | 30 | 29 | 58 | S. |
| Ann. var. — 19″.09 × 11¼ = | — | 3 | 40 | |
| Dec. of Fomalhaut, July 1845, | 30 | 26 | 18 | S. |
| | ° | ′ | ″ | |
| Obs. alt. of Fomalhaut ..... | 73 | 36 | 0 | S. |
| Corr. Table XV. — 4′.9 = | — | 4 | 54 | |
| True alt. of Fomalhaut ..... | 73 | 31 | 6 | |
| | 90 | | | |
| Star's zenith distance..... | 16 | 28 | 54 | N. |
| Star's declination, July 1845... | 30 | 26 | 18 | S. |
| Latitude ..... | 13 | 57 | 24 | S. |

### EXAMPLES FOR EXERCISE.

1. April 6, 1835, at about 9h. P. M., the meridian altitude of the Star Regulus was 50° 14′ South of the observer, the height of his eye being 18 feet: required the latitude.

Answer. 52° 37′ North.

2. December 16, 1840, at about 1h. A. M., the meridian altitude of the Star Sirius was 36° 28′ 30″, the observer being North of the star, and the height of his eye 14 feet: required the latitude.

Answer. 37° 6′ 14″ North.

3. March 25, 1845, at about 4h. 15m. A. M., the meridian altitude of the Star Antares was 71° 19′ 45″ N., the height of the eye being 22 feet, and the index error of the instrument + 2′ 10″: required the latitude.

Answer. 44° 47′ 48″ South.

### *To find the Latitude by the Meridian Altitude of a Planet.*

RULE. From the observed altitude of the planet subtract the dip and refraction, and to the remainder add the parallax in altitude: the result will be the true altitude of the planet; which, subtracted from 90°, will give the zenith distance, as before, and under this set the declination, reduced to Greenwich mean time*; then the sum, or difference of the zenith distance and declination, according as they are of the same, or contrary names, will give the latitude, of the same name with the greater.

* The Rule for reducing the time at the place of observation, to the corresponding time at Greenwich, is given in Page 155.

NOTE. The time of the meridian passage, together with the declination and other elements of the planets, are given for Greenwich mean time, in the Nautical Almanac for 1835, from Pages 267 to 358. The declination is to be reduced to the time of observation at the meridian of Greenwich, by proportion, or by Table XXXIII., as shewn in the Explanation of that Table.

The horizontal parallax of the planets for Greenwich mean noon, are contained in the Nautical Almanac for 1835, from Pages 359 to 361, from which the parallax in altitude is to be found by Table XLVIII.

## EXAMPLE I.

January 3, 1835, in longitude 15° W., the meridian altitude of the planet Mars was 57° 42′ 30″, the observer being north of the planet, and the height of his eye 17 feet: required the latitude.

In Page 291 of the Nautical Almanac, the mean time of the planet's meridian passage is 11h. 58m.;* and in Page 360, his horizontal parallax is nearly 14″.

| | h. | m. | | |
|---|---|---|---|---|
| Mean time at ship ..... | 11 | 58 | | |
| Long. in time (Tab. XIX.) | 1 | 0 W. | | |
| Mean time at Greenwich... | 12 | 58 | | |
| | ° | ′ | ″ | |
| Decl. of Mars, Jan. 3, | 26 | 49 | 28 N. | |
| Ditto, Jan. 4, | 26 | 52 | 32 N. | |
| Var. in 24 hours ..... | | 3 | 4 | Log. .8935 |
| Greenwich mean time | 12h. | 58m. | | Log. .2674 |
| | ° | ′ | ″ | |
| Var. in 12h. 58m..... | + | 1 | 39 | Log. 1.1609 |
| Dec. of Mars at mean noon, Jan. 3 ... | 26 | 49 | 28 N. | |
| Ditto at Greenwich mean time..... | 26 | 51 | 7 N. | |

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Observed mer. alt. of Mars ... | 57 | 42 | 30 | |
| Dip of the horizon ..... | — | 3 | 57 | |
| Apparent mer. alt. of Mars ... | 57 | 38 | 33 | |
| Refraction ..... | — | 0 | 36 | |
| | 57 | 37 | 57 | |
| Par. in altitude (Tab. XLVIII) | + | | 8 | |
| True mer. alt. of Mars ..... | 57 | 38 | 5 | |
| | 90 | | | |
| True zenith distance ..... | 32 | 21 | 55 | N. |
| Declination at Greenwich time | 26 | 51 | 7 | N. |
| Latitude ..... | 59 | 13 | 2 | N. |

## EXAMPLE II.

December 12, 1835, in longitude 50° E., the meridian altitude of Jupiter was 37° 15′ 45″, the observer being south of the planet, and the height of his eye 20 feet: required the latitude.

In Page 334 of the Nautical Almanac the mean time of Jupiter's passage over the meridian of Greenwich, on the given day, is found to be 13h. 34m.; and in Page 360, his horizontal parallax is 2″.

* The time of the planet's meridian passage, in the Nautical Almanac, being given to the meridian of Greenwich, it ought in strictness to be reduced to the time of its passage over the meridian of the place of observation; but it will be sufficiently exact, in the present case, to take the time for the given day, as predicted in the Almanac.

| | h. | m. | | | |
|---|---|---|---|---|---|
| Mean time at ship ..... | 13 | 34 | | | |
| Long. in time (XIX) ... | 3 | 20 | E. | | |
| Mean time at Greenwich | 10 | 14 | | | |
| | ° | ′ | ″ | | |
| Dec. of Jup. Dec. 12... | 22 | 47 | 6 | N. | |
| Ditto Dec. 13... | 22 | 47 | 56 | N. | |
| Var. in 24 hours..... | | 0 | 50 | Log. 1.4594 | |
| Greenwich mean time | | 10h. | 14m. | Log. .3702 | |
| | ° | ′ | ″ | | |
| Var. in 10h. 14m..... | + | 0 | 21 | Log. 1.8296 | |
| Decl. of Jupiter at noon, Dec. 12. | 22 | 47 | 6 | N. | |
| Ditto, at Greenwich time..... | 22 | 47 | 27 | N. | |

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Obs. mer. alt. of Jupiter ..... | 37 | 15 | 45 | |
| Dip of the horizon ..... | − | 4 | 17 | |
| App. mer. alt. of Jupiter ..... | 37 | 11 | 28 | |
| Refraction ..... | − | 1 | 15 | |
| | 37 | 10 | 13 | |
| Parallax in alt. (XLVIII.) ... | + | | 1 | |
| True mer. alt. of Jupiter ..... | 37 | 10 | 14 | |
| | 90 | | | |
| True zenith distance ..... | 52 | 49 | 46 | S. |
| Declin. at Greenwich time ... | 22 | 47 | 27 | N. |
| Latitude ..... | 30 | 2 | 19 | S. |

## EXAMPLES FOR EXERCISE.

1. February 22, 1835, in longitude 76° W., the meridian altitude of the Planet Jupiter was 80° 15′ 30″ S., the height of the observer's eye being 18 feet, and the index error of the instrument — 1′ 25″: required the latitude.

Answer. 30° 2′ 47″ North.

2. May 20, 1835, in longitude 34° 30′ E., the meridian altitude of the Planet Saturn was 64° 49′ 30″, the zenith being south of the planet, the height of the observer's eye 18 feet, and the error of the instrument + 3′ 10″: required the latitude.

Answer. 29° 26′ 5″ South.

### *To find the Latitude by the meridian Altitude of the Moon.*

Rule 1. In Page IV. of the month in the Nautical Almanac, find the mean time of the moon's passing the meridian of Greenwich on the given day, which reduce to the time of her passing the meridian of the ship by Table XVI.

2. With the above time, and the ship's longitude, find the corresponding Greenwich mean time, as directed in Page 155.

3. From Page III. of the month in the Nautical Almanac, take out the moon's semidiameter and horizontal parallax, and reduce them to the mean time at Greenwich;* and to the semidiameter add the moon's augmentation, taken from Table VII.

* The moon's horizontal parallax and semidiameter are reduced to the time at Greenwich thus: Take them out for the nearest noon or midnight before and after the Greenwich time, and find their difference; then say, for each, as 12 hours is to the difference in 12 hours, so is the Greenwich time since the preceding noon or midnight, to a proportional part; which being added to, or subtracted from, the horizontal parallax and semidiameter, at the preceding noon or midnight, according as they are increasing or decreasing, will give them reduced to the time of observation; or the proportional parts may be taken out by inspection from Table LIV. But, in general, it will be sufficiently exact to take them out for the nearest noon or midnight, without applying the proportional parts.

4. From the observed altitude (corrected for index error, if any) subtract the dip of the horizon (Table V.), and to the remainder add the moon's augmented semidiameter, when the lower limb is observed; or subtract it, if the upper limb be taken; the result will be the apparent altitude of the moon's centre.

5. From Table XXX. take out the correction answering to the moon's apparent altitude and horizontal parallax, and add it to the apparent altitude; the sum will be the true altitude of the moon's centre, which, subtracted from 90 degrees, will give the zenith distance, to be called North or South, according as the observer is north or south of the moon: under this set the moon's declination, taken from Pages V. to XII. of the month in the Nautical Almanac, for the given day and hour at Greenwich, and reduced to the mean time at Greenwich by Table XLVII.† Now the sum, or difference, of the zenith distance and declination, according as they are of the same or contrary names, will give the latitude of the place of observation, of the same name with the greater.

## EXAMPLE I.

May 7, 1835, in longitude 84° E., the meridian altitude of the moon's lower limb was 67° 35′ 30″, the observer being south of the moon, and the height of his eye 21 feet: required the latitude.

| | h. | m. | | |
|---|---|---|---|---|
| Moon's mer. passage at Greenwich... | 7 | 55 | | |
| Corr. for long. 84° E. (Table XVI.) | — | 12 | | |
| Moon's mer. passage at ship ..... | 7 | 43 | | |
| Longitude in time (Table XIX.) ... | 5 | 36 E. | | |
| Mean time at Greenwich..... | 2 | 7 | | |
| | ° | ′ | ″ | |
| D's dec. May 7, at 2 hrs. | 13 | 56 | 45 N. | |
| Ditto at 3 hrs. | 13 | 43 | 51 N. | |
| Variation in 1 hour ... | | 12 | 54 Log. | .6676 |
| Greenw. time aft. 2 hrs. | | 7m.0s. | Log. | .9331 |
| Var. in 7 minutes..... | — | 1 | 30 Log. | 1.6007 |
| D's decl. May 7, at 2 hrs. | 13 | 56 | 45 N. | |
| Ditto at Greenwich mean time..... | 13 | 55 | 15 N. | |

In Page III. of May in the Naut. Almanac, the Moon's semidiam. at noon 7th, is 15′ 54″, and the horizontal parallax 58′ 22″.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Obs alt. moon's lower limb ... | 67 | 35 | 30 | |
| Dip of the horizon ..... | — | 4 | 23 | |
| App. alt. moon's lower limb ... | 67 | 31 | 7 | |
| Moon's semidiameter, 15′ 54″ Augment. (Tab. VII.) + 15 | + | 16 | 9 | |
| App. alt. moon's centre..... | 67 | 47 | 16 | |
| Correction (Table XXX.)..... | + | 21 | 41 | |
| True alt. moon's centre..... | 68 | 8 | 57 | |
| | 90 | | | |
| True zenith distance ..... | 21 | 51 | 3 S. | |
| Moon's declin. at Greenw. time | 13 | 55 | 15 N. | |
| Latitude ..... | 7 | 55 | 48 S. | |

## EXAMPLE II.

November 27, 1835, in longitude 22° 30′ W., the meridian altitude of the moon's lower limb was 72° 12′ 20″, the zenith being north of the moon, the height of the observer's eye 20 feet, and the error of the instrument − 2′ 10″: required the latitude.

† See the explanation of this Table, with Examples.

| | h. m. |
|---|---|
| Moon's mer. passage at Greenwich . | 6 39 |
| Corr. for long. 22°30′ W. (Tab. XVI.) | + 2 |
| Moon's mer. passage at ship ..... | 6 41 |
| Longitude in time (Table XIX.) ... | 1 30 W. |
| Mean time at Greenwich ..... | 8 11 |

| | ° ′ ″ | |
|---|---|---|
| ☽'s dec. Nov. 27, at 8 hrs. | 11 26 5 S. | |
| Ditto, at 9 hrs. | 11 13 0 S. | |
| Variation in 1 hour ... | 13 5 | Log. 6614 |
| Green. time after 8 hrs. | 11 m. 0 s. | Log. 7368 |
| | ′ ″ | |
| Var. in 11 minutes ... | — 2 24 | Log. 1.3982 |
| Moon's dec. Nov. 27, at 8 hours ..... | 11 26 5 S. | |
| Ditto, at Greenwich mean time ..... | 11 23 41 S. | |

In Page III. of November in the Nautical Almanac, the Moon's semidiam. on the 27th, at 8 h. 11 m. Greenwich time, is 15′ 22″, and horizontal parallax 56′ 23″.

| | ° ′ ″ |
|---|---|
| Obs. alt. moon's lower limb ... | 72 12 20 |
| Index error ..... | — 2 10 |
| | 72 10 10 |
| Dip of the horizon ..... | — 4 17 |
| App. alt. moon's lower limb ... | 72 5 53 |
| Moon's semidiam... 15′ 22″ / Augmen. (Tab. VII.) + 15 | + 15 37 |
| App. alt. of moon's centre..... | 72 21 30 |
| Correction (Table XXX)..... | + 16 48 |
| True alt. of moon's centre..... | 72 38 18 |
| | 90 |
| True zenith distance ..... | 17 21 42 N. |
| Moon's declination ..... | 11 23 41 S. |
| Latitude ..... | 5 58 1 N. |

## EXAMPLE III.

July 15, 1835, in longitude 92° 30′ W., the meridian altitude of the moon's upper limb was 55° 47′ 45″ N., the height of the observer's eye being 18 feet, and the index error + 1′ 30″: required the latitude.

| | h. m. |
|---|---|
| Moon's mer. passage at Greenwich | 16 58 |
| Cor. for long. 92°30′ W. (Tab. XVI) | + 10 |
| Moon's mer. passage at ship ..... | 17 8 |
| Longitude in time (Tab. XIX).... | 6 10 W. |
| Mean time at Greenwich..... | 23 18 |

| | ° ′ ″ | |
|---|---|---|
| ☽'s dec. July 15, at 23 hrs. | 0 7 38 S. | |
| Ditto, July 16, at 0 hr. | 0 5 42 N. | |
| Variation in 1 hour ... | 0 13 20 | Log. 6532 |
| Greenw. time after 23 hrs. | 18 m. 0 s. | Log. 5229 |
| | ′ ″ | |
| Var. in 18 minutes ... | — 4 0 | Log. 1.1761 |
| Moon's dec. July 15, at 23 hours..... | 0 7 38 S. | |
| Ditto, at Greenwich mean time ..... | 0 3 38 S. | |

In Page III. of July in the Nautical Almanac, the moon's semidiameter at noon the 16th, is 15′ 0″, and horizontal parallax 55′ 4″.

| | ° ′ ″ |
|---|---|
| Obs. alt. moon's upper limb.... | 55 47 45 N. |
| Index error ..... | + 1 30 |
| | 55 49 15 |
| Dip of the horizon ..... | — 4 4 |
| App. alt. moon's upper limb.... | 55 45 11 |
| Moon's semidiameter 15 0 / Augmen. (Tab. VII.) + 13 | — 15 13 |
| App. alt. of moon's centre..... | 55 29 58 |
| Correction (Table XXX.) ..... | + 30 32 |
| True alt. of moon's centre..... | 56 0 30 |
| | 90 |
| True zenith distance ..... | 33 59 30 S. |
| Moon's declin. at Greenw. time | 0 3 28 S. |
| Latitude ..... | 34 2 58 S. |

## EXAMPLES FOR EXERCISE.

1. October 12, 1835, in longitude 172° W., the meridian altitude of the moon's upper limb was 35° 18′ 40″ north of the zenith, the height of the observer's eye being 17 feet, and the error of the instrument + 1′ 40″: required the latitude.

Answer. 27° 56′ 58″ South.

2. January 6, 1835, in longitude 87° E., the meridian altitude of the moon's lower limb was 73° 45′ 50″ south of the observer, the height of his eye being 20 feet, and the index error — 4′ 10″: required the latitude.

Answer. 15° 52′ 59″ North.

### *To find the Latitude by a meridian Altitude below the Pole.*

When the complement of the declination of an object is less than the latitude of a place, and they are both of the same name, the object comes to the opposite meridian without setting at that place, and in this case is said to be on the meridian below the Pole; if the altitude be then taken, the latitude may thence be found as follows:

RULE. Correct the declination and observed altitude, as before; then to the true altitude add the complement of the declination, (found by subtracting the declination from 90°): the sum will be the latitude, of the same name with the declination.

### EXAMPLE I.

June 29, 1835, in longitude 12° E, the meridian altitude of the sun's lower limb, at midnight, was 6°30′15″, the height of the observer's eye being 20 feet: required the latitude.

| | h. | m. | |
|---|---|---|---|
| App. time at ship | 12 | 0 | |
| Longitude in time (Table XIX.) | | 48 | E. |
| App. time at Greenwich | 11 | 12 | |
| | ° | ′ | ″ | |
| Sun's declin. June 29, at noon, (Page I. Naut. Alm.) | 23 | 16 | 43 | N. |
| Corr. for 11h. 12m. (Tab. XXI.) | — | 1 | 34 | |
| Sun's declin. at Greenwich time | 23 | 15 | 9 | N. |
| | 90 | | | |
| Sun's Co. declination | 66 | 44 | 51 | N. |
| | ° | ′ | ″ | |
| Obs. alt. sun's lower limb. | 6 | 30 | 15 | |
| Dip of the horizon | — | 4 | 17 | |
| App. alt. sun's lower limb. | 6 | 25 | 58 | |
| Refr. parallax (Tab. XVIII.) | — | 7 | 47 | |
| True alt. sun's lower limb. | 6 | 18 | 11 | |
| Sun's semidiameter | + | 15 | 45 | |
| True alt. sun's centre | 6 | 33 | 56 | |
| Sun's Co. declination | 66 | 44 | 51 | N. |
| Latitude | 73 | 18 | 47 | N. |

### EXAMPLE II.

July 26, 1845, the altitude of the star Dubhe in Ursa Major, when on the meridian below the Pole, was 21° 14′ 0″, the height of the observer's eye being 16 feet, and the index error + 1′ 30″: required the latitude.

By Table XLIV. the time of Dubhe's passing the meridian above the Pole is 2h. 31m. P. M.; therefore 12h. after that time, or about 2h. 31m. A. M., it will be on the meridian below the Pole.

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Declin. of Dubhe, 1834 | 62 | 38 | 45 | N. |
| Ann. var. — 19″.22 × 11½ = | — | 3 | 41 | |
| Declin. of Dubhe, July 1845 | 62 | 35 | 4 | N. |
| | 90 | | | |
| Star's Co. declination | 27 | 24 | 56 | N. |
| | ° | ′ | ″ | |
| Obs. alt. of Dubhe | 21 | 14 | 0 | |
| Index error | + | 1 | 30 | |
| | 21 | 15 | 30 | |
| Dip of the horizon | — | 3 | 50 | |
| App. alt. of Dubhe | 21 | 11 | 40 | |
| Refraction | — | 2 | 26 | |
| True alt. of Dubhe | 21 | 9 | 14 | |
| Star's Co. declination | 27 | 24 | 56 | N. |
| Latitude | 48 | 34 | 10 | N. |

### EXAMPLES FOR EXERCISE.

1. July 13, 1835, in longitude 76° 30′ W., the altitude of the sun's lower limb, when on the meridian below the Pole, was 8° 26′ 30″ S, the height of the observer's eye being 10 feet, and the index error + 3′ 15″: required the latitude.

Answer. 76° 47′ 11″ North.

2. August 9, 1839, at about 3h. A. M., the star $\alpha$ in Crux being on the meridian below the Pole, its altitude was observed to be 17° 32′ 30″, the height of the observer's eye being 18 feet, and the index error − 2′ 25″: required the latitude.

Answer. 45° 10′ 24″ South.

### *To find the Latitude by an Altitude of the Polar Star.*

RULE. To the Sun's right ascension, taken from Table XIV., add the time since noon when the altitude was observed: their sum (rejecting 24 hours, if it exceed that quantity) will be the right ascension of the meridian, with which enter Table XVII., and add the corresponding correction to, or subtract it from, the star's true altitude, as directed in the Table: the sum, or remainder, will be the approximate Latitude, to which add the correction, taken from Table XVII.* and the sum will be the Latitude, always North.†

#### EXAMPLE I.

May 21, 1835, the altitude of the Polar Star was observed to be 50° 18′, at 10h. 15m. past noon, the height of the observer's eye being 20 feet: required the latitude.

| | h. | m. |
|---|---|---|
| Sun's right ascension, May 21st ... | 3 | 51 |
| Time of observation ..... | 10 | 15 |
| Right ascension of meridian ..... | 14 | 6 |

| | ° | ′ | ″ |
|---|---|---|---|
| Obs. alt. of the Polar Star ..... | 50 | 18 | 0 |
| Dip of the horizon ..... | − | 4 | 17 |
| App. alt. of the Polar Star..... | 50 | 13 | 43 |
| Refraction ..... | − | 0 | 48 |
| True alt. of the Polar Star..... | 50 | 12 | 55 |
| Correction (Table XVII.) ... + | 1 | 30 | 0 |
| Approximate latitude ..... | 51 | 42 | 55 |
| Corr. (Tab. XVII.*) ... 0′.2 = + | 0 | 1 | 2 |
| Latitude..... | 51 | 43 | 7 N. |

#### EXAMPLE II.

January 16, 1840, at 9h. 30m. past noon, the altitude of the Polar Star was 67° 36′, the height of the observer's eye being 30 feet: required the latitude.

| | h. | m. |
|---|---|---|
| Sun's right ascension, Jan. 16th... | 19 | 51 |
| Time of observation ..... | 9 | 30 |
| | 29 | 21 |
| Subtract ..... | 24 | |
| Right ascension of meridian ..... | 5 | 31 |

| | ° | ′ | ″ |
|---|---|---|---|
| Obs. alt. of the Polar Star..... | 67 | 36 | 0 |
| Dip of the horizon ..... | − | 5 | 15 |
| App. alt. of the Polar Star ... | 67 | 30 | 45 |
| Refraction ..... | − | | 23 |
| True alt. of the Polar Star ... | 67 | 30 | 22 |
| Correction (Table XVII.) ..... | − | 36 | 0 |
| Approximate latitude ..... | 66 | 54 | 22 |
| Corr. (Tab. XVII.*)...2′.9 = | + | 2 | 54 |
| Latitude ..... | 66 | 57 | 16 N. |

† In the new Nautical Almanacs, Rules and Tables are given for finding the Latitude by an Altitude of the Polar Star, to the nearest second.

The nearer the star is to the meridian, either above or below the Pole, when the observation is made, the less will be the error in latitude, arising from an error in the supposed time. The time of the star's passing the meridian may be easily obtained by consulting Table XLIV.; see also the Explanation to that Table.

EXAMPLES FOR EXERCISE.

1. September 6, 1845, at 11h. 50m. P. M., the altitude of the Polar Star was 31° 35′, the height of the observer's eye being 22 feet, and the index error + 2′ 20″: required the latitude.

Answer. 30° 15′ 35″ North.

2. March 11, 1840, at 15h. 30m. (or 3h. 30m. past midnight, March 12), the altitude of the Polar Star was 75° 26′ 30″, the height of the observer's eye being 20 feet: required the latitude.

Answer. 76° 44′ 58″ North.

*To find the Latitude by two observed Altitudes of the Sun, and the Time elapsed between the Observations; having also the Latitude by Account, and the Sun's Declination when the greater Altitude was taken.*

Rule 1. To the log. secant of the latitude by account (XXV.), add the log. secant of the sun's declination; their sum, rejecting 20 from the index, call the *log. ratio.*

2. From the natural sine of the greater altitude (XXVI.) subtract the natural sine of the less altitude, and set the logarithm of their difference (XXIV.) under the log. ratio.

3. Take out the logarithm answering to half the elapsed time (XXVII.), and set it likewise under the log. ratio.

4. Add these three logarithms together, and find the middle time corresponding to their sum (XXVIII.), the difference between which and the half-elapsed time, will be the time from noon when the greater altitude was observed.*

5. From the log. rising, answering to this time (XXIX.), subtract the log. ratio, and the remainder will be the logarithm of a natural number (XXIV.); which being found, and added to the natural sine of the greater altitude, their sum will be the natural co-sine of the meridian zenith distance (XXVI.)

6. Having found the meridian zenith distance, apply to it the reduced declination, as directed in Page 180, and the result will be the latitude at the time of taking the greater altitude.

7. If the latitude thus found, should differ considerably from the latitude by account, the operation is to be repeated, using the computed latitude

* When the middle time is greater than the half-elapsed time, both observations will be on the same side of the meridian; otherwise, on different sides.

instead of that by account, until the latitude last found agree nearly with the latitude used in the computation.*

### *Remarks on the Times of Observation.*

As the above method is only an approximation to the truth, it must be used under the following restrictions, *viz.*

The observations must be taken between nine o'clock in the forenoon and three in the afternoon. If both observations be in the forenoon, or both in the afternoon, the elapsed time must not be less than the time from noon when the greater altitude is taken. If one observation be taken in the forenoon, and the other in the afternoon, the elapsed time must not exceed four hours and a half; and in all cases, the nearer the greater altitude is to noon, the better.

If the sun's meridian zenith distance † be less than the latitude, the limitations are still more contracted. If the latitude be double the meridian zenith distance, the observations must be taken between half past nine in the forenoon, and half past two in the afternoon; and the interval, or elapsed time, must not exceed three hours and a half. The observations must be taken still nearer to noon, if the latitude exceed the meridian zenith distance in a greater proportion.

## EXAMPLE I.

May 22, 1836, in latitude 41° 45′ N. by account, at 11h. 28m. in the forenoon, the true altitude of the sun's centre was 67° 16′, and at 0h. 24m. 40s. P. M. it was 68° 24′: required the true latitude.

| Times. | | | | Altitudes. | Nat. Sines. | | | |
|---|---|---|---|---|---|---|---|---|
| 11h. | 28m. | 0s. | A. M. | 67° 16′ | 92231 | Lat. by acc... 41° 45′ | Secant | 0.12723 |
| 0 | 24 | 40 | P. M. | 68 24 | 92978 | Declination... 20 27 | Secant | 0.02827 |
| | | | | | | Log. ratio | | 0.15550 |
| 0 | 56 | 40 | | Diff. | 747 | Log. | | 2.87332 |
| 0 | 28 | 20 | Half-elapsed time | | | Log. | | 0.90899 |
| 0 | 9 | 55 | Middle time | | | Log. | | 3.93781 |
| 0 | 18 | 25 | Time from noon | | | Log. rising | | 2.50679 |
| | | | | | | Log. ratio | | 0.15550 |
| | | | Natural number | | 226 | Log. | | 2.35329 |
| | | | Natural sine of greater altitude | | 92978 | | | |
| | | | Nat. co. sine of mer. zen. dist. | | 93204 | = 21° 15′ N. | | |
| | | | Declination | | | 20 27 N. | | |
| | | | Latitude... | | | 41 42 N. | | |

* Dr. Brinkley, Professor of Astronomy in the University of Dublin, has published a Set of Rules for solving this Problem, which are annexed to the Nautical Almanac for the year 1822.

† The meridian zenith distance is equal to the sum of the latitude and declination, when they are of contrary names; or their difference, when of the same name.

## EXAMPLE II.

August 9, 1836, in latitude 50° 40′ N. by account, at 11h. 36m. 29s. in the forenoon, the altitude of the sun's lower limb was 53° 18′; and at 1h. 13m. 53s. in the afternoon, its altitude was 51° 59′, the height of the observer's eye being 26 feet; required the true latitude.

| | ° | ′ | | ° | ′ |
|---|---|---|---|---|---|
| First obs. alt. of sun's lower limb... | 53 | 18 | Second obs. alt. of sun's lower limb. | 51 | 59 |
| Corr. from Table IX. + 10′.1 or... | + | 10 | Corr. from Table IX. + 10′.1 or... | + | 10 |
| True altitude..... | 53 | 28 | True altitude ..... | 52 | 9 |

| Times. | Altitudes. | Nat. Sines. | | | | |
|---|---|---|---|---|---|---|
| 12h. 0m. 0s. | 53° 28′ | ..... 80351 | Lat. by acc. ..... | 50° 40′ | ...Secant | 0.19803 |
| 11 36 29 A. M. | 52 9 | ..... 78962 | Declination ..... | 15 48 | ...Secant | 0.01673 |
| | | | Log. ratio ..... | | | 0.21476 |
| 23 31 | | Diff. 1389 | ..... Log. ..... | | | 3.14270 |
| 1 13 53 P. M. | | | | | | |
| 1 37 24 Elapsed time. | | | | | | |
| 0 48 42 Half-elapsed time ..... | | | Log. ..... | | | 0.67592 |
| 0 12 23 Middle time ..... | | | Log. ..... | | | 4.03338 |
| 0 36 19 Time from noon ..... | | | Log. rising ..... | | | 3.09787 |
| | | | Log. ratio ..... | | | 0.21476 |
| Natural number..... | 764 | ..... | Log. ..... | | | 2.88311 |
| Natural sine of greater altitude.....80351 | | | | | | |
| Nat. co-sine of mer. zen. distance.. 81115 = 35° 47′ N. | | | | | | |
| Declination 15 48 N. | | | | | | |
| Latitude... 51 35 N. | | | | | | |

As the latitude resulting from this computation differs 55′ from the latitude by account, the operation must be repeated, using the latitude last found, instead of the latitude by account.

| | | | |
|---|---|---|---|
| Latitude last found..... | 51° 35′ | ...Secant | 0.20665 |
| Declination ..... | 15 48 | ...Secant | 0.01673 |
| Log. ratio..... | | | 0.22338 |
| Difference of natural sines.....1389 | ..... Log..... | | 3.14270 |
| Half-elapsed time .....0h. 48m. 42s. | ..... Log..... | | 0.67592 |
| Middle time..... 0 12 38 | ..... Log..... | | 4.04200 |
| Time from Noon ..... 0 36 4 | ..... Log. rising ..... | | 3.09187 |
| | Log. ratio ..... | | 0.22338 |
| Natural number ..... 789 | ..... Log. ..... | | 2.86849 |
| Natural sine of greater altitude ..... 80351 | | | |
| Nat. co-sine of mer. zen. distance .... 81090 = 35° 49′ N. | | | |
| Declination 15 48 N. | | | |
| Latitude... 51 37 N. | | | |

As this latitude differs only two miles from the latitude by the first operation, it may therefore be esteemed the true latitude.

In the preceding examples both observations were supposed to be taken in the same place; but as this is seldom the case, it will be necessary, when the ship is making much way, and the elapsed time is considerable, to correct the less altitude, in order to find what it would have been, had it been taken at the place where the greater altitude was observed; which is to be done as follows:

Let the bearing of the sun be observed by compass, at the time of taking the *less altitude*, and find the number of points contained between that and the ship's course by compass, between the observations, corrected for lee-way, if she make any, which subtract from 16, when it is more than 8 points; likewise compute the distance run during the elapsed time: with these enter Table I., and find the corresponding difference of latitude, which will be the correction for the change of station.

If the *less altitude* be observed in the *forenoon*, the correction is to be added to it, if the above angle be less than 8 points; but when it is more, to be subtracted.

If the *less altitude* be observed in the *afternoon*, the correction is to be subtracted, if the angle be less than 8 points; but when greater, it is to be added to the less altitude.

The less altitude being thus corrected, proceed according to the Rule, and the result will be the latitude of the ship when the greater altitude was observed.

## EXAMPLE III.

November 10, 1837, latitude by account 32° 30′ N., at 9h. 30m. A.M. the altitude of the sun's lower limb was 28° 14′, the bearing of its centre by compass being S. E. ½ E.; and at 11h. 17m. 42s. A.M. the altitude of the upper limb was 39° 8′; the height of the observer's eye being 18 feet, and the ship's course between the observations S. by E., running 7 knots per hour; required the latitude of the ship at the time of the latter observation.

The elapsed time between the observations is nearly 1 hour 48 minutes, and her rate of sailing 7 miles per hour; therefore, as 1 hour : 7 miles : : 1h. 48m. : 12 miles, the distance run between the observations.

Sun's bearing at first observation, S. E. ½ E. or S. 4½ Pts. E.
Ship's course during the elapsed time, S. by E. or S. 1 Pt. E.

Angle between them ..... 3½ Pts. which being taken as a course, in Table I. and the distance run during the elapsed time 12 miles, as a distance, give in the latitude column 9 miles nearly, to be added to the less altitude, according to the above Rule.

| | ° | ′ |
|---|---|---|
| Obs. alt. of sun's lower limb ..... | 28 | 14 |
| Dip. of the horizon ..... | − | 4 |
| | 28 | 10 |
| Refraction ..... | − | 2 |
| | 28 | 8 |
| Semidiameter ..... | + | 16 |
| True altitude of sun's centre ..... | 28 | 24 |
| Corr. for ship's way ..... | + | 9 |
| Sun's reduced altitude ..... | 28 | 33 |

| | ° | ′ |
|---|---|---|
| Obs. alt. of sun's upper limb ..... | 39 | 8 |
| Dip of the horizon ..... | − | 4 |
| | 39 | 4 |
| Refraction ..... | − | 1 |
| | 39 | 3 |
| Semidiameter ..... | − | 16 |
| True altitude of sun's centre ..... | 38 | 47 |

| Times. | Altitudes. | Nat. Sines. | | |
|---|---|---|---|---|
| 9h. 30m. 0s. | A.M. 28° 33′ ..... | 47793 | Lat. by acc. 32° 30′ ...Secant | 0.07397 |
| 11 17 42 | A.M. 38 47 ..... | 62638 | Declination 17 11 ...Secant | 0.01983 |
| | | | Log. ratio ..... | 0.09380 |
| 1 47 42 | Elapsed time Diff. 14845 ..... | | Log. ..... | 4.17158 |
| 0 53 51 | Half-elapsed time..... | | Log. ..... | 0.63299 |
| 1 33 14 | Middle time ..... | | Log. ..... | 4.89837 |
| 0 39 23 | Time from noon ..... | | Log. rising ..... | 3.16822 |
| | | | Log. ratio..... | 0.09380 |
| | Natural number 1187 ..... | | Log..... | 3.07442 |

Natural sine of greater alt. ... 62638

Nat. co-sine of mer. zen. dist... 63825 = 50° 20′ N.

Declination 17 11 S. .....Secant 0.01983

Latitude... 33 9 N. .....Secant 0.07715

| h. m. s. | | | |
|---|---|---|---|
| | | Log. ratio ..... | 0.09698 |
| | Diff. nat. sines 14845 ..... | Log. ..... | 4.17158 |
| 0 53 51 | Half-elapsed time..... | Log. ..... | 0.63299 |
| 1 33 57 | Middle time ..... | Log. ..... | 4.90155 |
| 0 40 6 | Time from noon ..... | Log. rising ..... | 3.18377 |
| | | Log. ratio ..... | 0.09698 |
| | Natural number... 1221 ..... | Log. ..... | 3.08679 |

Natural sine of greater alt. ... 62638

Nat. co-sine of mer. zen. dist. 63859 = 50° 19′ N.

Declination 17 11 S.

Latitude ... 33 8 N.

## EXAMPLE IV.

October 8, 1835, in latitude 60° 10′ N. by account, and longitude 139° W., the altitude of the sun's lower limb was observed to be 19° 41′ at 10h. 4m. 20s. apparent time in the forenoon, his centre bearing S. S. E. by compass, and at 1h. 32m. 36s. afternoon, it was 21° 8′. The ship's course during the elapsed time was N. W. by N., sailing at the rate of 9 knots per hour, and the height of the observer's eye 16 feet: required the latitude of the ship at the time of taking the greater altitude.

| | h. | m. | | ° | ′ | ″ |
|---|---|---|---|---|---|---|
| App. time at ship at greater alt... | 1 | 38 | Sun's dec. Oct. 8, by page 1, N.A. | 5 | 42 | 43 S. |
| Longitude in time ..... | 9 | 16 W. | Corr. for Greenwich time (XXI.) + | 10 | 17 | |
| Greenwich apparent time ..... | 10 | 49 | Sun's declination at Greenw. time | 5 | 53 | 0 S. |

The angle between the sun's bearing, S. S. E., and the ship's course, N. W. by N., is 15 points; which shews that the ship has sailed within 1 point of the direction opposite the sun. Now 1 point taken out as a course in Table I., and 31 miles, the distance run in 3h. 28m., the elapsed time between the two observations, give in the latitude column 30 miles, to be applied to the less altitude, according to the rule in page 194.

| | ° ′ | | ° ′ |
|---|---|---|---|
| First obs. alt. of sun's lower limb ... | 19 41 | Second obs. alt. of sun's lower limb. | 21 8 |
| Corr. Table IX + 9′.7 or ..... | + 10 | Corr. Table IX + 9′.8 or ..... | + 10 |
| True altitude ..... | 19 51 | True altitude..... | 21 18 |
| Corr. for ship's way ..... | − 30 | | |
| Reduced altitude ..... | 19 21 | | |

| Times. | | | | Altitudes. | Nat. Sines. |
|---|---|---|---|---|---|
| 12h. | 0m. | 0s. | | 19° 21′ | 33134 |
| 10 | 4 | 20 | A.M. | 21 18 | 36325 |
| 1 | 55 | 40 | | Diff. | 3191 |
| 1 | 32 | 36 | P.M. | | |
| 3 | 28 | 16 | Elapsed time | | |
| 1 | 44 | 8 | Half-elapsed time | | |
| 0 | 16 | 51 | Middle time | | |
| 1 | 27 | 17 | Time from noon | | |

Lat. by acc. ... 60° 10′ ... Secant 0.30323
Declination..... 5 53 ... Secant 0.00229
Log. ratio ..... 0.30552
Diff. 3191..... Log. ..... 3.50393
Log. ..... 0.35763
Log. ..... 4.16708
Log. rising ..... 3.85521
Log. ratio ..... 0.30552
Natural number..... 3545 ..... Log. ..... 3.54969
Natural sine of greater alt. ..... 36325
Nat. co-sine of mer. zen. dist. ... 39870 = 66° 30′ N.
Declination 5 53 S. ..... Secant 0.00229
Latitude... 60 37 N. ..... Secant 0.30923

| h. | m. | s. | | |
|---|---|---|---|---|
| | | | Log. ratio ..... | 0.31152 |
| | | | Diff. nat. sines 3191.....Log. ..... | 3.50393 |
| 1 | 44 | 8 | Half-elapsed time .....Log. ..... | 0.35763 |
| 0 | 17 | 5 | Middle time..... Log. ..... | 4.17308 |
| 1 | 27 | 3 | Time from noon .....Log. rising..... | 3.85291 |
| | | | Log. ratio ..... | 0.31152 |
| | | | Natural number ..... 3478.....Log. ..... | 3.54139 |
| | | | Natural sine of greater alt. ..... 36325 | |
| | | | Nat. co-sine of mer. zen. dist. ... 39803 = 66° 33′ N. | |
| | | | Declination 5 53 S. | |
| | | | Latitude... 60 40 N. | |

## EXAMPLE V.

May 7, 1835, in latitude 29° 10′ S., and longitude by account 38° E., at 9h. 49m. 20s. by a chronometer*, the observed altitude of the sun's upper limb was 45° 33′; and at 10h. 44m. 45s. by the same chronometer, the observed altitude of his lower limb was 42° 8′ 30″, at which time it bore N. ¼ E. by compass. The ship's course between the observations was

* The chronometer is here used, for the purpose of measuring the elapsed time more accurately than by a common watch.

N. W. ¼ N. on the starboard tack, running at the rate of 6 knots per hour, and making 1 point lee-way, the height of the observer's eye being 22 feet, and the apparent time at the meridian of the ship, when the greater altitude was observed, about 0h. 20m. P. M.: required the latitude of the ship when the greater altitude was taken.

| | h. m. | | ° ′ ″ |
|---|---|---|---|
| App. time at ship at great. alt., May 7, | 0 20 | Sun's declin., May 6, by N. A. | 16 24 41 N. |
| | 24 | Correction for 12 hrs... 8′ 30″ } | + 15 30 |
| | | Ditto for 9h. 48m. ...7 0 } | |
| Ditto, past noon, May 6 ..... | 24 20 | | |
| Longitude in time ..... | 2 32 E. | Sun's declin. at Greenw. time. | 16 40 11 N. |
| Greenwich app. time, May 6 ..... | 21 48 | | |

The ship's course N. W. ¼ N., corrected for 1 point lee-way, gives N. W. ¾ W., and the angle this makes with the sun's bearing N. ¼ E., is 5 points; which, taken as a course in Table I., and 6 miles, the distance run during 55 minutes, the interval between the observations, as a distance, give in the latitude column 3 miles, to be subtracted from the second or less altitude, according to the Rule in page 194.

| | ° ′ ″ | | ° ′ ″ |
|---|---|---|---|
| Obs. alt. of sun's upper limb..... | 45 33 0 | Obs. alt. of sun's lower limb..... | 42 8 30 |
| Dip of the horizon ..... | — 4 30 | Dip of the horizon ..... | — 4 30 |
| App. alt. of sun's upper limb ... | 45 28 30 | App. alt. of sun's lower limb ... | 42 4 0 |
| Refraction ..... | — 56 | Refraction ..... | — 1 3 |
| True alt. of sun's upper limb ... | 45 27 34 | True alt. of sun's lower limb ... | 42 2 57 |
| Sun's semidiameter by N. A..... | — 15 52 | Sun's semidiameter by N. A..... | + 15 52 |
| True altitude of sun's centre ... | 45 11 42 | True altitude of sun's centre ... | 42 18 49 |
| | | Corr. for ship's way ..... | — 3 0 |
| | | Sun's reduced altitude ..... | 42 15 49 |

| Times by Chron. | | | Altitudes. | Nat. Sines. | | |
|---|---|---|---|---|---|---|
| 9h. | 49m. | 20s. | ..... 45° 12′ | ..... 70957 | Lat. by acc...29° 10′...Secant | 0.05888 |
| 10 | 44 | 45 | ..... 42 16 | ..... 67258 | Declination..16 40 ...Secant | 0.01864 |
| | | | | | Log. ratio ..... | 0.07752 |
| 0 | 55 | 25 | | Diff. 3699 ..... | Log ..... | 3.56808 |
| 0 | 27 | 42 | Half-elapsed time ..... | | Log. ..... | 0.91875 |
| 0 | 42 | 16 | Middle time..... | | Log. ..... | 4.56435 |
| 0 | 14 | 34 | Time from noon ..... | | Log. rising..... | 2.30602 |
| | | | | | Log. ratio .. ..... | 0.07752 |
| | | | Natural number ... | 169..... | Log. ..... | 2.22850 |

Natural sine of greater altitude ... 70957

Nat. co.-sine of mer. zen. dist..... 71126 = 44° 40′ S.

Declination 16 40 N.

Latitude ... 28 0 S.

By repeating the operation, the latitude comes out the same as above.

*A direct Method of finding the Latitude by two Altitudes of the Sun, the Time elapsed between the Observations, and the Sun's Declination when the greater Altitude was observed.**

RULE 1. Add together the *true altitudes* (found as before), and take half their sum; subtract the less altitude from the greater, and take half their difference.

2. Find the interval between the times of observing the two altitudes, which call *elapsed time;* take half of the elapsed time, and reduce it to degrees, &c. by Table XIX.

3. Add together the *co-secant* of half the elapsed time (reduced as above)† and the *secant* of the declination; their sum will be the *co-secant* of *arc first.*

4. Add together the *co-secant* of arc first, the *co-sine* of half the sum of the altitudes, and the *sine* of half their difference: the sum of these logarithms will be the *sine* of *arc second.*

5. Add together the *secant* of arc first, the *sine* of half the sum of the altitudes, the *co-sine* of half their difference, and the *secant* of arc second; their sum will be the *co-sine* of *arc third.*

6. Add together the *secant* of arc first (already found), and the *sine* of the declination; their sum will be the *co-sine* of *arc fourth*, when the latitude and declination are of the same name; but when they are of contrary names, take the supplement for *arc fourth.*

7. Take the sum or difference of arcs third and fourth, for *arc fifth.* (See Note.)

8. Add together the *secants* of arc second (already found) and arc fifth; their sum will be the *co-secant* of the *Latitude.*

NOTE. When the sum of arcs third and fourth is equal to, or greater than 90°, their difference is always *arc fifth;* but when their sum is less than 90° (which will rarely happen), it may be doubtful whether their sum or difference ought to be taken for *arc fifth.* But the computation is soon made on both suppositions, for the secant of arc fifth is the last logarithm which is taken from the Table, and the other parts of the calculation are therefore not affected by the change: one of the results must certainly be the required latitude, and the latitude by account will generally be sufficient to determine which of them ought to be taken.

*Remarks.*

In this method the observations should, if possible, be taken under the same limitations as directed in the former (page 192); these, however, may, in case of necessity, be considerably extended, if the altitudes be taken with care, the elapsed time measured by a chronometer, and the logarithms and arcs taken out to the nearest second.

* This method of finding the Latitude by two Altitudes of the Sun, which is much simpler and more general than the former, and independent of the Latitude by Account, was proposed by Mr. James Ivory, who has given an ingenious Solution of it in the Philosophical Magazine for August 1821. Mr. Riddle, of the Royal Naval Asylum, Greenwich, has since considerably improved Mr. I.'s Solution, and given a Rule, similar to the above, in the same work for September 1822.

† The Log of the half-elapsed time may be taken from Table XXVII., which will save the trouble of reducing the time to degrees, &c.

In both the methods no allowance is made for the change of the sun's declination during the interval between the observations. This, indeed, might be done; but the operation would be more complicated, while the omission will produce no error of consequence to the navigator, especially if the interval be not considerable.

It will much facilitate the operation if a formula be written out before the commencement of the calculation; and it should be observed, that many of the logarithms may be obtained at the same opening of the Table: thus, the secant and sine of the declination; the secant and co-secant of arc first, the former of which is wanted twice; the sines and co-sines of half the sum and difference of the altitudes; and the sine and secant of arc second; these being taken out together, will considerably expedite the calculation.

## EXAMPLE I. (Page 192.)

| Altitudes. | | Times. | | | | | ° ′ |
|---|---|---|---|---|---|---|---|
| 67° 16′ | | 11h. 28m. 0s. | A. M. | Latitude by account... | | | 41 45 N. |
| 68 24 | | 0 24 40 | P. M. | Declination | | | 20 27 N. |
| | ° ′ | | | | | | |
| Sum.....135 40 | half 67 50 | 0 56 40 | Elapsed time. | | | | |
| Diff..... 1 8 | half 0 34 | 0 28 20 | Half-elapsed time = 7° 5′ | | | | |
| Half elapsed time | 7° 5′ | Co-secant | 0.90899 | | | | |
| Sun's declination . | 20 27 | Secant ... | 0.02827 | | | Sine... | 9.54331 |
| Arc first ..... | 6 38 | Co-secant | 0.93726 | Secant ... | 0.00292 | Secant | 0.00292 |
| Half sum alts..... | 67 50 | Co-sine . | 9.57669 | Sine ..... | 9.96665 | | |
| Half diff. alts..... | 0 34 | Sine ..... | 7.99520 | Co-sine... | 9.99998 | | |
| Arc second..... | 1 51 | Sine ..... | 8.50915 | Secant .... | *0.00023 | | |
| Arc third ..... | 21 8 | | | Co-sine... | 9.96978 | | |
| Arc fourth ..... | 69 24 | | | | | Co-sine | 9.54623 |
| Arc fifth ..... | 48 16 | Secant ... | 0.17675 | | | | |
| | | Secant ... | *0.00023 | | | | |
| Latitude ..... | 41 42 | Co-secant | 0.17698 | | | | |

## EXAMPLE II. (Page 193.)

| Altitudes. | | Times. | | | | | ° ′ |
|---|---|---|---|---|---|---|---|
| 53° 28′ | | 11h. 36m. 29s. | A. M. | Latitude by account ... | | | 50 40 N. |
| 52 9 | | 1 13 53 | P. M. | Declination | | | 15 48 N. |
| | ° ′ | | | | | | |
| Sum... 105 37 | half 52 48½ | 1 37 24 | Elapsed time. | | | | |
| Diff.... 1 19 | half 0 39½ | 0 48 42 | Half-elapsed time 12° 10′½ | | | | |
| Half-elapsed time | 12° 10′½ | Co-secant | 0.67593 | | | | |
| Sun's declination . | 15 48 | Secant.... | 0.01673 | | | Sine... | 9.43502 |
| Arc first..... | 11 42½ | Co-secant | 0.69266 | Secant ... | 0.00913 | Secant | 0.00913 |
| Half sum alts..... | 52 48½ | Co-sine... | 9.78138 | Sine ..... | 9.90125 | | |
| Half diff. alts..... | 0 39½ | Sine..... | 8.06031 | Co-sine... | 9.99997 | | |
| Arc second..... | 1 58 | Sine..... | 8.53435 | Secant ... | *0.00026 | | |
| Arc third ..... | 35 31 | | | Co-sine... | 9.91061 | | |
| Arc fourth..... | 73 51 | | | | | Co-sine | 9.44415 |
| Arc fifth ..... | 38 20 | Secant ... | 0.10545 | | | | |
| | | Secant.... | *0.00026 | | | | |
| Latitude ..... | 51 37 | Co-secant | 0.10571 | | | | |

## EXAMPLE III. (Page 194.)

| Altitudes. | Times. | | |
|---|---|---|---|
| ° ′ | h. m. s. | | ° |
| 28 33 ..... | 9 30 0 A.M. | Latitude by account..... | 33 30 N. |
| 38 47 ..... | 11 17 42 A.M. | Declination ..... | 17 11 S. |
| ° ′ | | | |
| Sum... 67 20 half 33 40 | 1 47 42 Elapsed time. | | |
| Diff.... 10 14 half 5 7 | 0 53 51 Half-elapsed time = 13° 27′ 45″ | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | ° ′ | | | | | |
| Half-elapsed time | 13 28 | Co-secant | 0.63287 | | | |
| Sun's declination . | 17 11 | Secant ... | 0.01983 | ..... Sine ... | | 9.47046 |
| Arc first..... | 12 51 | Co-secant | 0.65270 | Secant ... | 0.01102 | .....Secant 0.01102 |
| Half sum alts..... | 33 40 | Co-sine... | 9.92027 | Sine ..... | 9.74379 | |
| Half diff. alts..... | 5 7 | Sine ..... | 8.95029 | Co-sine... | 9.99827 | |
| Arc second..... | 19 29 | Sine ..... | 9.52326 | Secant ... | *0.02561 | |
| Arc third..... | 53 5 | ..... | ..... | Co-sine... | 9.77869 | |
| Arc fourth.....107 38 = (180° − 72° 22′) ..... | | | | | | Co-sine 9.48148 |
| Arc fifth..... | 54 33 | Secant ... | 0.23658 | | | |
| | | Secant ... | *0.02561 | | | |
| | ° ′ | | | | | |
| Latitude ..... | 33 9 N. | Co-secant | 0.26219 | | | |

## EXAMPLE IV. (Page 195.)

| Altitudes. | Times. | | |
|---|---|---|---|
| ° ′ | h. m. s. | | ° ′ |
| 19 21 ..... | 10 4 20 A.M. | Latitude by account ..... | 60 10 N. |
| 21 18 ..... | 1 32 36 P.M. | Declination..... | 5 53 S. |
| ° ′ | | | |
| Sum... 40 39 half 20 19½ | 3 28 16 Elapsed time. | | |
| Diff.... 1 57 half 0 58½ | 1 44 8 Half-elapsed time = 26° 2′ | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | ° ′ | | | | | |
| Half-elapsed time | 26 2 | Co-secant | 0.35764 | | | |
| Sun's declination . | 5 53 | Secant ... | 0.00229 | ..... Sine... | | 9.01074 |
| Arc first ..... | 25 53 | Co-secant | 0.35993 | Secant..... | 0.04591 | .....Secant 0.04591 |
| Half sum alts..... | 20 19½ | Co-sine... | 9.97208 | Sine..... | 9.54076 | |
| Half diff. alts..... | 0 58½ | Sine..... | 8.23086 | Co-sine ... | 9.99994 | |
| Arc second ..... | 2 6 | Sine..... | 8.56287 | Secant ..... | *0.00029 | |
| Arc third..... | 67 16½ | ..... | ..... | Co-sine.... | 9.58690 | |
| Arc fourth ..... | 96 32½ = (180° − 83° 27′½) | .... | ..... | ..... | | Co-sine 9.05665 |
| Arc fifth..... | 29 16 | Secant ... | 0.05931 | | | |
| | | Secant ... | *0.00029 | | | |
| | ° ′ | | | | | |
| Latitude ..... | 60 49 N. | Co-secant | 0.05960 | | | |

## EXAMPLE V.

September 9, 1835, in latitude by account 6° 30′ N., at 0h. 24m. 20s. by a chronometer, shewing Greenwich mean time, the altitude of the sun's lower limb was 69° 49′ 30″, and at 2h. 44m. 20s. by the same chronometer, the altitude was 35° 10′ 30″, the instrument being adjusted, and the height of the observer's eye 18 feet: required the latitude at the time the greater altitude was taken.*

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Sun's declination for mean noon September 9, by Page II. of Nautical Almanac | 5 | 30 | 24 | N. |
| Corr. for Greenwich mean time, 0h. 24m., when the greater alt. was taken ... | — | 0 | 23 | |
| Sun's declination at Greenwich mean time ..... | 5 | 30 | 1 | N. |

| | ° | ′ | ″ | | ° | ′ | ″ |
|---|---|---|---|---|---|---|---|
| First obs. alt. of sun's low. limb | 69 | 49 | 30 | Second obs. alt. of sun's low. limb. | 35 | 10 | 30 |
| Corr. Table IX. + 11′.4 = | + | 11 | 24 | Corr. Table IX. + 10′.5 = | + | 10 | 30 |
| Sun's true alt. at first obs.... | 70 | 0 | 54 | Sun's true alt. at second obs..... | 35 | 21 | 0 |

| Altitudes. ° ′ | | | Times by Chron. h. m. s. | |
|---|---|---|---|---|
| 70 | 1 | ..... | 0 24 20 | |
| 35 | 21 | ..... | 2 44 20 | |
| Sum ... | 105 | 22 | half 52 41 | 2 20 0 Elapsed time. |
| Diff.... | 34 | 40 | half 17 20 | 1 10 0 Half-elapsed time = 17° 30′ |

| | ° | ′ | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Half-elapsed time | 17 | 30 | ...Co-secant | 0.52186 | | | | |
| Sun's declination. | 5 | 30 | ...Secant..... | 0.00200 | ..... | Sine... | 8.98157 | |
| Arc first..... | 17 | 25 | ...Co-secant | 0.52386 | ...Secant ... | 0.02038 | .....Secant | 0.02038 |
| Half sum alts. .... | 52 | 41 | ...Co-sine... | 9.78263 | ...Sine ..... | 9.90053 | | |
| Half diff. alts. .... | 17 | 20 | ...Sine ..... | 9.47412 | ...Co-sine... | 9.97982 | | |
| Arc second..... | 37 | 7 | ...Sine..... | 9.78061 | ...Secant ... | *0.09832 | | |
| Arc third..... | 3 | 47 | ..... | | Co-sine... | 9.99905 | | |
| Arc fourth..... | 84 | 14 | ..... | | ..... | | Co-sine | 9.00195 |
| Arc fifth..... | 80 | 27 | ...Secant ... | 0.78013 | | | | |
| | | | Secant ... | *0.09832 | | | | |
| Latitude ..... | 7 | 36 N. | ...Co-secant | 0.87845 | | | | |
| Arc fifth..... | 88 | 1 | .....Secant ... | 1.46081 | | | | |
| | | | Secant ... | *0.09832 | | | | |
| Latitude ..... | 1 | 35 N. | ...Co-secant | 1.55913 | | | | |

The sum of the third and fourth arcs being less than 90°, this example admits of two answers: first, by taking the difference of the arcs, the latitude comes out 7° 36′; and by taking their sum, the latitude will be 1° 35′; but it is evident that the former, agreeing nearly with the latitude by account, will be the required latitude.

* See the third Example worked by Dr. Brinkley's method in the Nautical Almanac for 1832, Pages 11 & 12.

Had this example been worked to seconds, the latitudes would have been 7° 37′ 29″ and 1° 33′ 3″.

NOTE. By the preceding method, the latitude may be found by two observed altitudes of a star; but in this case it will be necessary to reduce the interval between the observations, as measured in mean solar time by a watch or chronometer, to sidereal time, by Table XXXVII., as explained in the use of that Table.

EXAMPLES FOR EXERCISE.

1. October 20, 1835, in latitude by account 50° 9′ N., at 0h. 34m. P. M. the sun's true altitude was 29° 15′, and at 2h. 46m. P. M. it was 20° 3′: required the true latitude.

Answer 50° 13′ North.

2. February 25, 1835, in latitude 49° 36′ N. by account, at 0h. 33m. P.M. the observed altitude of the sun's lower limb was 28° 53′, and at 2h. 43m. P.M. it was 19° 44′, the height of the observer's eye being 14 feet: required the true latitude.

Answer, 51° 14′ North.

3. July 8, 1835, in latitude 58° 25′ N. by account, and longitude 111° E., at 11h. 2m. A.M. per watch, the altitude of the sun's lower limb was 52° 53′, and at 1h. 25m. P.M. the altitude was 52° 44′, the sun at that time bearing S. W. by W. by compass; the height of the observer's eye being 20 feet, and the ship's course during the elapsed time S. S.W. ½ W., sailing at the rate of 8 knots per hour: required the ship's true latitude at the time when the greater altitude was observed.

Answer, 57° 23′ North.

4. August 30, 1835, in latitude 12° 43′ S. by account, and longitude 168° 15′ W., at 11h. 13m. 30s. A.M., the altitude of the sun's lower limb was 66° 9′ 30″, and at 1h. 15m. 12s. P.M. it was 62° 0′ 15″, bearing at that time N. W. ½ W.: during the elapsed time the ship was sailing S. W. by W. at the rate of 4 knots per hour, and the height of the observer's eye was 28 feet: required the true latitude at the time of taking the greater altitude.

Answer, 11° 37′ South.

*To find the Latitude by an Altitude of the Sun taken near the Meridian: having the Apparent Time from Noon, the Latitude by Account, and the Sun's Declination at the Time of Observation.*

RULE 1. From the observed altitude, find the sun's true altitude, and reduce the declination, taken from Page I. of the month in the Nautical Almanac, to the apparent time of observation, by Table XXI. or XXXIII.

2. Add together the log. rising of the time from noon (XXIX.)
the log. co-sine of the latitude (XXV.)
and the log. co-sine of the declination;
the natural number corresponding to the sum of these three logarithms (rejecting the tens in the index) (XXIV.) being found, and added to the

natural sine (XXVI.) of the true altitude, will give the natural co-sine of the meridian zenith distance, to which apply the declination, as before, and the result will be the latitude.

Should the latitude thus found, differ materially from the latitude by account, it will be advisable to repeat the operation, using that latitude instead of the latitude by account.

NOTE. The apparent time at the ship when the altitude is taken, may be ascertained by altitudes observed when the sun is at a proper distance from the meridian, as shewn hereafter, and the error it then had, applied to the time shewn by the same watch when the altitude is taken; and should the ship have changed her meridian since the error of the watch was ascertained, the difference of longitude made, must be reduced into time by Table XIX., and added thereto, if east, or subtracted from it, if west.

Or, the apparent time at the ship may be obtained by means of a chronometer shewing mean time at Greenwich, by applying to that time the equation taken from Page II. of the month in the Nautical Almanac, in order to reduce it to apparent time at Greenwich: to this add the longitude of the ship (reduced into time by Table XIX.) if it be east, or subtract it, if west, and the result will be the apparent time at the ship.

The observations should be taken within the following limits, *viz.* the number of the minutes in the time from noon, should not exceed the number of degrees of the sun's meridian zenith distance. (See Note at the bottom of Page 192).

## EXAMPLE I.

October 11, 1835, in latitude by account 46° 10′ N., and longitude 158° E., the altitude of the sun's lower limb was 36° 33′ at 0h. 28m. 10s. P. M., by a watch previously regulated; the height of the observer's eye being 16 feet: required the true latitude.

| | ° | ′ | ″ |
|---|---|---|---|
| Obs. alt. of sun's lower limb... | 36 | 33 | 0 |
| Dip of the horizon ..... | − | 3 | 50 |
| | 36 | 29 | 10 |
| Refraction ..... | − | 1 | 17 |
| | 36 | 27 | 53 |
| Sun's semidiameter by N. A.... | + | 16 | 3 |
| Sun's true altitude ..... | 36 | 43 | 56 |

| | h. | m. | s. |
|---|---|---|---|
| Time from noon..... | 0 | 28 | 10 |
| Latitude by acc..... | 46° | 10′ | N. |
| Sun's declination ..... | 6 | 42 | S. |
| True altitude ..... | 36 | 44 | |
| Mer. zenith distance... | 52 | 54 | N. |
| Sun's declination ..... | 6 | 42 | S. |
| Latitude..... | 46 | 12 | N. |

| | h. | m. |
|---|---|---|
| App. time at ship Oct. 11 ..... | 0 | 28 |
| | 24 | |
| Ditto afternoon, Oct. 10 ..... | 24 | 28 |
| Longitude in time (Table XIX.)... | 10 | 32 E. |
| App. time at Greenwich Oct. 10... | 13 | 56 |
| Sun's dec. Oct. 10, by page 1 of N.A. | 6° | 28′ 29″ S. |
| Corr. for 12h. 0m. (XXI.) 11′ 20″ | | |
| Ditto for 1h. 56m. ..... 1 52 | + | 13 12 |
| Sun's declination at Greenwich time | 6 | 41 41 S. |

| | | |
|---|---|---|
| .....Rising ..... | 2. | 87753 |
| .....Co-sine..... | 9. | 84046 |
| .....Co-sine..... | 9. | 99702 |
| Nat. number 519.....Log..... | 2. | 71501 |
| Nat sine..... 59809 | | |
| Nat. co-sine 60328 | | |

## EXAMPLE II.

July 3, 1835, in latitude by account 27° 50′ S., and longitude 114° W., at 11h. 48m. 40s. A.M. (being July 2, at 23h. 48m. 40s. astronomical time), by a watch, whose error had been previously found to be 7m. 30s. too fast for apparent time at ship *, the altitude of the sun's upper limb was 41° 2′ N., the height of the observer's eye being 21 feet, and the ship having made 38 miles of longitude to the eastward since the watch was regulated: required the true latitude of the place of observation.

| | h. m. s. |
|---|---|
| Time of observation per watch ..... | 11 48 40 |
| Watch too fast..... | − 7 30 |
| Time corrected for the error of watch ..... | 11 41 10 |
| Longitude made in time (XIX.) ..... | + 2 32 E. |
| The time of observation after midnight ..... | 11 43 42 |
| | 12 0 0 |
| Ditto before noon July 3..... | 0 16 18 |

| | ° ′ ″ |
|---|---|
| Obs. alt. of sun's upper limb... | 41 2 0 |
| Dip of the horizon..... | − 4 23 |
| | 40 57 37 |
| Refraction ..... | − 1 5 |
| | 40 56 32 |
| Sun's semidiameter, by N. A. | − 15 45 |
| Sun's true altitude... ..... | 40 40 47 |

| | h. m. |
|---|---|
| App. time at ship July 2, ..... | 23 44 |
| Longitude in time (XIX.) ..... | 7 36 W. |
| | 31 20 |
| | 24 |
| App. time at Greenwich, July 3 ... | 7 20 |

| | ° ′ ″ |
|---|---|
| Sun's dec. July 3, by page 1, N. A. | 23 1 26 N. |
| Corr. for Greenwich time (XXI.) | − 1 30 |
| Sun's declination at Greenw. time | 22 59 56 N. |

| | h. m. s. |
|---|---|
| Time from noon ..... | 0 16 18 |

| | ° ′ |
|---|---|
| Latitude by account... | 27 50 S. |
| Sun's declination..... | 23 0 N. |
| True altitude ..... | 40 41 |
| Mer. zenith distance . | 49 9½ S. |
| Sun's declination..... | 23 0 N. |
| Latitude..... | 26 9½ S. |

| | |
|---|---|
| .....Rising ..... | 2.40266 |
| .....Co-sine ..... | 9.94660 |
| .....Co-sine ..... | 9.96403 |
| Nat. number 206 Log..... | 2.31329 |
| Nat. sine ... 65188 | |
| Nat. co-sine 65394 | |

## EXAMPLE III.

September 22, 1835, in latitude by account 50° 10′ N. and longitude 20° 36′ W., the altitude of the sun's lower limb was 40° 12′ 15″ S., when a chronometer shewed 2h. 1m. 50s. mean time at Greenwich; the error of the instrument being + 1′ 20″, and the height of the observer's eye 20 feet: required the true latitude.

* See the Rules for finding the time and error of the watch further on.

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean time at Greenwich by Chronometer..... | 2 | 1 | 50 | |
| Equation of time, Sept. 22, by page II, of N. A. | + 7 | 10 | | |
| App. time at Greenwich by Chronometer ..... | 2 | 9 | 0 | |
| Longitude of ship in time (Table XIX.) ..... | 1 | 22 | 24 | W. |
| Apparent time at ship ..... | 0 | 46 | 36 | |

| | ° | ′ | ″ | | | ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|
| Sun's dec. Sept. 22, by page 1, N. A. | 0 | 30 | 11 | N. | Obs. alt. sun's lower limb..... | 40 | 12 | 15 |
| Cor. for app. time at Greenw. (XXI.) | − | 2 | 7 | | Index error..... ..... | + | 1 | 20 |
| Sun's declin. at Greenwich time.. | 0 | 28 | 4 | N. | | 40 | 13 | 35 |
| | | | | | Corr. (Table IX.) + 10′.4 =... | + | 10 | 24 |
| | | | | | Sun's true altitude..... | 40 | 23 | 59 |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| Time from noon ..... | 0 | 46 | 36 | .....Rising ..... | 3.31388 |
| Latitude by account ... | 50° | 10′ | N. | .....Co-sine ..... | 9.80656 |
| Sun's declination ..... | 0 | 28 | N. | .....Co-sine ..... | 9.99999 |
| | | | | Nat. number 1320 .....Log..... | 3.12043 |
| Sun's true altitude ... | 40 | 24 | | ...Nat. sine ... 64812 | |
| Sun's true zen. dist. ... | 48 | 36 | N. | Nat. Co-sine 66132 | |
| Sun's declination ..... | 0 | 28 | N. | | |
| Latitude ..... | 49 | 4 | N. | | |

By repeating the operation, with the latitude as above, the true latitude comes out 49° 2½′ N.

## EXAMPLES FOR EXERCISE.

1. May 9, 1835 (civil time), in latitude by account 38° 26′ S., and longitude 22° 40′ E., the altitude of the sun's upper limb was 33° 21′ 30″ N., when a watch, previously regulated, shewed 11h. 10m. 15s. A. M., the height of the observer's eye being 24 feet, and the error of the instrument + 2′ 15″: required the true latitude.

Answer. 38° 32½′ South.

2. November 10, 1835, in latitude by account 60° 12′ N., and longitude 32° 30′ W., at 0h. 56m. 12s. P. M., by a watch whose error had been previously found to be 4m. 18s. too slow for apparent time at ship, the altitude of the sun's lower limb was 11° 48′ 45″ south of the zenith, the height of the observer's eye being 18 feet, and the ship having made 24 miles of longitude to the westward, since the error of the watch was found: required the true latitude.

Answer. 60° 4′ North.

3. March 15, 1835 (civil time), in latitude by account 47° 42′ S., and longitude 168° 20′ E., the altitude of the sun's lower limb was 44° 6′ 15″ N., when a chronometer shewed 12h. 25m. 55s. mean time at Greenwich, March 14, the error of the instrument being − 2′ 0″, and the height of the observer's eye 12 feet: required the true latitude.

Answer. 47° 46′ South.

# ON THE VARIATION OF THE COMPASS.

THE VARIATION OF THE COMPASS is the deviation of the points of the Mariner's Compass from the corresponding points of the horizon, and is termed *east* or *west* variation, according as the magnetic needle, or north point of the compass, is inclined to the eastward or westward of the true north point of the horizon.

For many years after the discovery of the compass, it was supposed that the needle exactly coincided with the plane of the meridian, and consequently that all the points of the compass agreed with the correspondent points of the horizon. In the year 1492, Columbus first observed that the needle deviated from the north and south points of the horizon; but still imagined this deviation was constantly the same: however, in 1634, Mr. Edward Gillibrand, Professor of Astronomy in Gresham College, discovered, from a comparison of his own observations with those of his predecessors, that the variation was not always the same at the same place; for in that year he found that the variation of the compass at Deptford was 4° 4′ East, which, compared with the same as observed by Mr. Burrows, in 1580, at Limehouse, who had found it to be 11° 15′ E., plainly shewed, that in the course of 54 years the variation had diminished more than 7 degrees. In 1657, according to Mr. Bond's observations, there was no variation of the compass at London: since that time the needle has been declining westward, and is at present about 24° 10′ West.*

It likewise appears, from observations made in various parts of the world, that in different places the variation differs both as to its quantity and denomination, being west in some places and east in others: thus, off the South Coast of Ireland the variation is at present about 30° West; but near Cape Horn, in South America, it is 22° East.

But besides the deviation of the needle from the plane of the true meridian, which it acquires after being touched with a magnet, it obtains another property called the *dip;* that is, although the needle be properly balanced beforehand, it will now lose its horizontal position, and one end will incline below the horizon, while the other will be elevated, so that it will be necessary to attach a weight to the elevated end, in order to restore it to a horizontal position when supported on the central pin. The angle that it makes with the horizon is called the *dip of the needle.* Near the equator it inclines but little from the horizontal plane; but one end is depressed the more as we advance towards the poles—the north end in the northern hemisphere, and the south end in the southern hemisphere.

The needle is also subject to a *local attraction*, resulting principally from the masses of iron on board ship, by which it will be drawn more or less from the magnetic meridian, according as the disturbing cause is

* According to the accurate observations of the late Colonel Beaufoy, made near London, the variation of the needle had arrived at its maximum in March 1819, when it was at noon 24° 41′ 42″ West; the needle has since that time been retrograding, the magnetic north gradually inclining to the eastward, and consequently the westerly variation decreasing.

situated with regard to the needle; this effect is called the *aberration of the needle*. Now, as a ship in traversing is constantly changing its direction, the iron contained therein must be carried by it into different positions with respect to the compass, and by its attraction will continually change the direction, of the needle. If westerly variation be increased, or easterly variation diminished, when the ship's head is in a westerly direction, the contrary effect will be produced when the ship's head is brought round to an easterly direction, that is, westerly variation will be diminished, and easterly increased: hence it will be necessary to determine the actual variation of the compass, when the ship's head is directed to different points of the horizon. In the northern hemisphere, when the compass is placed at or near the binnacle, the north point of the needle is attracted or drawn forward towards the ship's head; and the south point, in the southern hemisphere.

The greatest aberration takes place when the ship's head is at or near the east or west points, and decreases towards the magnetic meridian, in the proportion of radius to the sine of the angle between the ship's head and the magnetic meridian.

The most simple method of ascertaining the aberration, and from thence the actual variation of the compass, when the ship's head is in any given direction, is to observe the variation when the ship's head is brought alternately to the east and west points; half the sum of these variations will be the true variation, and half the difference will be the greatest aberration of the needle, arising from local attraction: then, to find the aberration, and from thence the actual variation, when the ship's head is on any other point of the compass, enter a Traverse Table with the given number of points from North or South, at the top or bottom, and the greatest aberration, reduced to minutes, in a distance column; opposite to which, in the corresponding departure column, will be found the aberration in minutes, when the ship's head is on the given point of the compass; then, if the ship be in the northern hemisphere, allow the aberration to the right-hand of the true variation, when the given point is to the eastward of the magnetic meridian, or to the left-hand when the given point is to the westward; but the contrary to this rule is to be observed when the ship is in the southern hemisphere: the result will give the actual variation when the ship's head is on the given point of the compass.

EXAMPLE. Suppose, when the ship's head bore east, being in north latitude, the observed variation was 21° 30′ W., but when the ship's head was put about to west, the observed variation was 27° 30′ W.: required the true variation independent of local attraction, the greatest aberration of the needle, and the actual variation when the ship's head is on each second point of the compass.

| | ° | ′ | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Variation with ship's head East ... | 21 | 30 W. | ..... | 21 | 30 W. |
| Variation with ship's head West... | 27 | 30 W. | ..... | 27 | 30 W. |
| 2) | 49 | 0 | | 2) | 6 | 0 | | |
| True variation..... | 24 | 30 | Greatest aberration ..... | 3 | 0=180′ |

Now, to find the aberration of the needle when the ship's head is two points from the north or south, enter Table 1, with two points at the top, and the greatest aberration 180′ in a distance column, opposite to which, in the corresponding departure column, will be 69′=1° 9′, the aberration required: this aberration being allowed to the right-hand when the ship's head is to the eastward, diminishes the true variation 24° 30′ W., and therefore subtracted from it leaves 23° 21′, the variation to be allowed when the ship's head is N. N. E. or S. S. E.; but as the aberration is to be allowed to the left-hand when the ship's head is to the westward, consequently increasing the variation, add the above together, and their sum 25° 39′ will be the variation when the ship's head is N. N. W. or S. S. W.

In the same manner the variations may be found, corresponding to the other points of the compass.

The variations may then be formed into a table as follows:

| Ship's Head by Compass. | Variations. | Ship's Head by Compass. | Variations. |
|---|---|---|---|
| | ° ′ | | ° ′ |
| North | 24 30 W. | South | 24 30 W. |
| N. N. E. | 23 21 | S. S. W. | 25 39 |
| N. E. | 22 23 | S. W. | 26 37 |
| E. N. E. | 21 44 | W. S. W. | 27 16 |
| East. | 21 30 | West | 27 30 |
| E. S. E. | 21 44 | W. N. W. | 27 16 |
| S. E. | 22 23 | N. W. | 26 37 |
| S. S. E. | 23 21 | N. N. W. | 25 39 |

Hence the variations to be allowed are opposite the courses steered: thus, if the ship's head is E. N. E., the variation to be allowed is 21° 44′ W.; but if W. S. W., the variation to be allowed is 27° 16′ W.

The observations for determining the variation should be made with an azimuth compass placed amidship on, or as near to, the binnacle as can be safely done; and the steering compass should be compared with the azimuth compass, to ascertain that there is no difference in the direction of the needles, since the local attraction of the iron in the ship will affect the needle differently in different parts of it.*

The VARIATION OF THE COMPASS is found by comparing together the sun's true and magnetic amplitudes or azimuths.

The TRUE AMPLITUDE of any celestial object is an arch of the horizon contained between the true east or west points thereof, and the centre of the object at the time of its rising or setting; or, it is the degrees and minutes the object rises or sets to the northward or southward of the true east or west points of the horizon.

The MAGNETIC AMPLITUDE is an arch contained between the east or west points of the compass and the centre of the object at rising or

* Mr. Barlow, of the Royal Military Academy at Woolwich, has invented an apparatus for neutralizing the effect of local attraction on the needle of the ship's compass; this consists of a small iron plate, fixed in such a situation behind, and near to, the steering compass, that its local action may exactly counterpoise the magnetic power of all the iron in the ship.

setting; or, it is the bearing of the object, by compass, when in the horizon.

The TRUE AZIMUTH of an object is an arch of the horizon contained between the true meridian and the azimuth, or vertical circle passing through the centre of the object.

The MAGNETIC AZIMUTH is an arch contained between the magnetic meridian and the azimuth, or vertical circle passing through the centre of the object; or it is the bearing of the object, by compass, at any time when it is above the horizon.

The true amplitude, or azimuth, is found by calculation; and the magnetic amplitude, or azimuth, by an azimuth compass.

The following is a description of Mr. M'Culloch's patent Azimuth Compass, with the method of observing amplitudes, or azimuths, by the same.

## DESCRIPTION OF THE AZIMUTH COMPASS.

Figure 2, Plate VIII., is a representation of the azimuth compass ready for observation. The needle in this compass is bent in such a manner, that the point of the conical pivot on which it moves, and is supported, may be brought very near to the centre of gravity, as well as to the centre of motion. The card is similar to those of the steering compass, with this difference only, that a circular ring of silvered brass, divided into 360°, or rather into four times 90°, circumscribes the card. *b* represents the compass box, which is brass, and has a hollow conical bottom. *e* is the prop upon which the compass is supported, instead of gimbols. It stands in a brass socket, screwed to the bottom of the wooden box, and may be turned round at pleasure. *h* is one of the guards; the other, being directly opposite, is hid by the box. Each guard has a slit, in which a pin, projecting from the side of the box, may move freely in a vertical direction. 1 is a brass bar, upon which, at right angles, the sight-vanes are fixed: a line is drawn along the middle of this bar; which line, the lines in the vanes, and the thread joining their tops, are all in the same plane. 2 is a coloured-glass, which may be moved up or down the sight-vane 3. 4 is a magnifying-glass, moveable on the other vane, whose focal distance is nearly equal to the distance between the vanes. 5 is the nonius, or vernier, which contains six divisions; and as the limb of the card is divided into half degrees, each division of the nonius is therefore five minutes. The interior surface of the nonius is ground concave to the segment of a circle of the same diameter as the circle of the card. 6 is a stopper, or screw, connected with the nonius, which serves to move the nonius close to the card, and thereby prevent it from vibrating as soon as the observation of the amplitude, or azimuth, is completed. 7 is a convex lens, to assist the eye in reading off the observed amplitude, or azimuth. 8 is a milled head, by which the card may be lifted off the centre, and prevented from vibrating, when the compass is not wanted for use.

## USE OF THE AZIMUTH COMPASS.

### *To observe the Sun's Amplitude.*

Turn the compass-box, until the vane containing the magnifying-glass is directed towards the sun; and when the bright speck, or rays of the sun collected by the magnifying-glass, falls upon the slit in the other vane, stop the card by means of the nonius, and read off the amplitude.

Without using the magnifying-glass, the sight may be directed through the dark glass towards the sun; and in this case, the card is to be stopped when the sun is bisected by the thread in the other vane.

The observation should be made when the sun's lower limb appears somewhat more than his semidiameter above the horizon, because his centre is really then in the horizon, although it is apparently elevated, on account of the refraction of the atmosphere: this is particularly to be noticed in high latitudes.

### *To observe the Sun's Azimuth.*

Raise the magnifying-glass to the upper part of the vane, and move the box, as before directed, until the bright speck falls on the other vane, or on the line in the horizontal bar; the card is then to be stopped, and the divisions being read off, will be the sun's magnetic azimuth.

If the card vibrate considerably at the time of observation, it will be better to observe the extreme vibrations, and take their mean as the magnetic azimuth. When the magnetic azimuth is observed, the altitude of the object must be taken, in order to obtain the true azimuth.

It will conduce much to accuracy, if several azimuths be observed, with the corresponding altitudes, and the mean of the whole taken for the observation.

### *To find the Variation of the Compass by an Amplitude.*

Rule 1. With the given time and longitude, find the corresponding time at Greenwich, by the Rules in page 155, and to that time reduce the sun's declination, (XXI.) taken from Table X., or the Nautical Almanac.

2. To the log. secant of the latitude of the ship, rejecting the index (XXV.), add the log. sine of the sun's reduced declination; their sum will be the log. sine of the true amplitude*, to be reckoned from the east in the morning, or from the west in the afternoon, towards the north or south, according to the declination.

3. Then, if the true and magnetic amplitudes be both north, or both south, their difference is the variation; but if one be north, and the other south, their sum is the variation: and to know whether it be easterly or westerly, suppose the observer looking towards that point of the compass representing the magnetic amplitude; then, if the true amplitude be to the right-hand of the magnetic, the variation is east, but if to the left-hand it is west.

* The true amplitude may likewise be found approximately by Table XLII.

## EXAMPLE I.

Required the sun's true amplitude on November 6, 1836, in latitude 48° 21′.

| | | | | |
|---|---|---|---|---|
| Latitude..... | 48° | 21′ | .....Secant... | 0.17745 |
| Declination ..... | 16 | 6 | S.....Sine..... | 9.44297 |
| True amplitude..... | 24 | 40 | .....Sine..... | 9.62042 |

Hence the sun will rise E. 24° 40′ S., or E. S. E. ½ S. nearly; and set W. 24° 40′ S., or W.S.W. ½ S. nearly.

## EXAMPLE II.

July 3, 1836, in latitude 9° 36′ S., the sun was observed to rise East 12° 42′ N.: required the variation of the compass.

| | | | | |
|---|---|---|---|---|
| Latitude ..... | 9° | 36′ | S.....Secant..... | 0.00613 |
| Declination ..... | 22 | 58 | N.....Sine ..... | 9.59128 |
| True amplitude, E. | 23 | 19 | N.....Sine ..... | 9.59741 |
| Mag. amplitude, E. | 12 | 42 | N. | |
| Variation | 10 | 37 | West, the true amplitude being to the *left* of the magnetic. | |

## EXAMPLE III.

September 24, 1836, in latitude 26° 32′ N., and longitude 79° W., the sun's centre was observed to set W. 6° 15′ S., about 6h. P. M.: required the variation of the compass.

| | h. | m. | | | ° | ′ | |
|---|---|---|---|---|---|---|---|
| Time at ship, Sept. 24..... | 6 | 0 | | Sun's declination (Table X.)..... | 0 | 34 | S. |
| Longitude in time (XIX).... | 5 | 16 | W. | Corr. for 11h. 16m. (Table XXI.). | + | 11 | |
| Time at Greenwich..... | 11 | 16 | | Sun's declin. at Greenwich time . | 0 | 45 | S. |

| | | | | |
|---|---|---|---|---|
| Latitude..... | 26° | 32′ | N.....Secant... | 0.04834 |
| Sun's declination ... | 0 | 45 | S.....Sine..... | 8.11693 |
| True amplitude, W. | 0 | 50 | S.....Sine..... | 8.16527 |
| Mag. amplitude, W. | 4 | 17 | S. | |
| Variation | 3 | 27 | East, the true amplitude being to the *right* of the magnetic. | |

## EXAMPLE IV.

Being at sea, in latitude 48° 36′ N., and longitude 20° West, on Feb. 15, 1835, I observed the sun's centre, at setting, W. 6° 45′ N., at 6h. 52m. P. M. apparent time: required the variation of the compass.

| | h. | m. | | | ° | ′ | ″ | |
|---|---|---|---|---|---|---|---|---|
| App. time at ship, Feb. 15..... | 6 | 52 | | Sun's declination by page I., N. A. | 12 | 48 | 46 | S. |
| Longitude in time (Table XIX.) | 1 | 20 | W. | Corr. for 8h. 12m. (Table XXI). | — | 6 | 49 | |
| App. time at Greenwich..... | 8 | 12 | | Sun's declin. at Greenw. time ... | 12 | 41 | 57 | S. |

| | | | | |
|---|---|---|---|---|
| Latitude..... | 43° | 36′ N. | Secant... | 0.14016 |
| Sun's declination .... | 12 | 42 S. | Sine..... | 9.34212 |
| True amplitude, W. | 17 | 46 S. | Sine..... | 9.48228 |
| Mag. amplitude, W. | 6 | 45 N. | | |
| Variation | 24 | 25 West, the true amplitude being to the *left* of the magnetic. | | |

## EXAMPLES FOR EXERCISE.

1. July 12, 1835, in latitude 42° 12′ S., and longitude 14° 46′ W., at 4h. 35m. P. M., apparent time, the sun set N. W. ½ W. by compass: required the variation.

Answer. 8° 57′ West.

2. December 10, 1835 (civil time), in latitude 54° 35′ N., and longitude 53° 15′ W., the sun's centre was observed to rise S. by E., at 8h. 27m. A. M., apparent time: required the variation of the compass.

Answer. 36° 34′ West.

3. March 9, 1835 (civil time), in latitude 10° 2′ S., and longitude 168° E., the sun's magnetic amplitude at rising was observed to be E. 6° 22′ N., at 5h. 57m. A. M., apparent time: required the variation of the compass.

Answer. 11° 23′, or 1 point nearly, East.

4. November 13, 1835, in latitude 32° 36′ N., and longitude 74° 15′ W., at 5h. 15m. P. M., apparent time, the sun was observed to set, by an azimuth compass, W. 21° 30′ S.: required the variation.

Answer. No variation.

5. March 21, 1835 (civil time), in latitude 52° 15′ N., and longitude 30° W., at 6h. 0m. A. M., apparent time, the sun's centre was observed to rise S. E. by E.: required the variation of the compass.

Answer. In this Example, the sun, having no declination, rises due East, and the magnetic amplitude being S. E. by E., or three points to the southward of East, the variation is three points West, the true amplitude being to the *left* of the magnetic.

### *To find the Variation of the Compass by an Azimuth.*

Rule 1. With the given time and longitude, find the corresponding time at Greenwich by the Rules in page 155, and to that time reduce the sun's declination, (XXI.) taken from Table X, or the Nautical Almanac; compute also the sun's true altitude.

2. Subtract the sun's declination from 90°, when the latitude and declination are of the same name, or add it to 90°, when they are of contrary names; and the sum, or remainder, will be the sun's polar distance.

3. Add together the sun's true altitude, the latitude of the ship, and the sun's polar distance; take the difference between half their sum and the polar distance, and note the remainder:

4. Then add together,
the log. secant of the altitude (XXV).
the log. secant of the latitude .....
the log. co-sine of the half sum,
and the log. co-sine of the remainder.
} rejecting their indices,

5. Half the sum of these four logarithms will be the sine of an arch, which doubled, will be the sun's true azimuth; to be reckoned from the south in north latitude, and from the north in south latitude; towards the east in the morning, and towards the west in the afternoon.

6. Then, if the true and observed azimuths be both reckoned from the north, or both from the south, their difference is the variation; but if one be reckoned from the north, and the other from the south, subtract the true azimuth from 180°, and the difference between the remainder and the magnetic azimuth will be the variation: and to know if it be east or west, suppose the observer looking towards that point of the compass representing the magnetic azimuth; then, if the true azimuth be to the right of the magnetic, the variation is east, but if the true be to the left of the magnetic the variation is west.

## EXAMPLE I.

July 20, 1837, in latitude 21° 42′ N., and longitude 62° E., at 7h. 4m. A.M. (or July 19, at 19h. 4m., astronomical time), the sun's azimuth, by the compass, was observed to be S. 100° 16′ E., at the same time that the altitude of his lower limb was 23° 36′; the height of the observer's eye being 24 feet: required the variation of the compass.

| | h. | m. | | | | ° | ′ | |
|---|---|---|---|---|---|---|---|---|
| Time at ship, July 19..... | 19 | 4 | Sun's declin. July 19 (Table X.) | | | 20 | 52 | N. |
| Longitude in time (Table XIX). | 4 | 8 E. | Corr. for 14h. 56m. (Table XXI.) ... | − 6′ 51″ or | − | 7 | | |
| Time at Greenwich ..... | 14 | 56 | Sun's declin. at Greenwich time... | | | 20 | 45 | N. |
| | ° | ′ | | | | 90 | | |
| Obs. alt. of sun's lower limb..... | 23 | 36 | | | | | | |
| Corr. Table IX. + 8′. 8 or ..... | + | 9 | Sun's polar distance..... | | | 69 | 15 | |
| True altitude of sun's centre | 23 | 45 | .....Secant ... | 0.03843 | | | | |
| Latitude..... | 21 | 42 | .....Secant ... | 0.03192 | | | | |
| Polar distance..... | 69 | 15 | | | | | | |
| Sum..... | 114 | 42 | | | | | | |
| Half-sum..... | 57 | 21 | .....Co-sine ... | 9.73200 | | | | |
| Remainder..... | 11 | 54 | .....Co-sine ... | 9.99057 | | | | |
| | | | | 2) 19.79292 | | | | |
| | 51 | 59 | .....Sine..... | 9.89646 | | | | |
| | 2 | | | | | | | |
| True azimuth .....S. | 103 | 58 E. | | | | | | |
| Magnetic azimuth ...S. | 100 | 16 E. | | | | | | |
| Variation | 3 | 42 | West, the true azimuth being to the *left* of the magnetic. | | | | | |

## EXAMPLE II.

November 2, 1836, in latitude 25° 32′ N., and longitude 85° W., the altitude of the sun's lower limb was observed to be 15° 37′, about 4h. 15m. P.M., his magnetic azimuth at that time being S. 58° 32′ W., and the height of the observer's eye 18 feet: required the variation of the compass.

| | h. m. | | ° ′ |
|---|---|---|---|
| Time at ship, Nov. 2 | 4 15 | Sun's declin. Nov. 2. (Table X.) | 14 52 S. |
| Longitude in time (Tab. XIX.) | 5 40 W. | Corr. for 9h. 55m. (Table XXI.) + 7′ 36″ or | + 8 |
| Time at Greenwich | 9 55 | Sun's declination at Greenwich time | 15 0 S. |
| | ° ′ | | 90 0 |
| Obs. alt. of sun's lower limb | 15 37 | | |
| Corr. Table IX. + 8′. 8 or | + 9 | Sun's polar distance | 105 0 |

| | | | |
|---|---|---|---|
| True alt. of sun's centre | 15 46 | Secant ... | 0.01666 |
| Latitude | 25 32 | Secant ... | 0.04463 |
| Polar distance | 105 0 | | |
| Sum | 146 18 | | |
| Half-sum | 73 9 | Co-sine... | 9.46220 |
| Remainder | 31 51 | Co-sine... | 9.92913 |
| | | | 2) 19.45262 |
| | 32 10½ | Sine... | 9.72631 |
| | 2 | | |
| True azimuth ..... S. | 64 21 W. | | |
| Magnetic azimuth... S. | 58 32 W. | | |
| Variation | 5 49 East, the true azimuth being to the *right* of the magnetic. | | |

## EXAMPLE III.

February 14, 1835, in latitude 36° 18′ S., and longitude 38° 30′ W., about half-past 6 A. M. (civil time), the following altitudes of the sun's lower limb, with the corresponding azimuths, were observed; the height of the observer's eye being 30 feet: required the variation of the compass.

| Azimuths. | Altitudes. | | h. m. | | ° ′ |
|---|---|---|---|---|---|
| ° ′ | ° ′ | Time at ship, Feb. 13, | 18 30 | Sun's dec. Feb. 13 (Ta. X) | 13 29 S. |
| S. 87 15 E. | 11 15 | Long. in time (T. XIX) | 2 34 W. | Cor. for 12h. (XXI) 9′ 48″ | − 17 |
| 87 0 | 11 52 | | | Ditto for 9h. 4m... 7 20 | |
| 86 40 | 12 44 | Time at Greenwich | 21 4 | | |
| 86 10 | 13 17 | | | Sun's dec. at Greenw. time | 13 12 S. |
| 85 45 | 13 50 | | ° ′ | | 90 |
| | | Obs. alt. sun's low. l. | 12 35 | | |
| 5) 432 50 | 62 58 | Cor. Ta. IX. + 6′. 7 or | + 7 | Sun's polar distance | 76 48 |
| Means S. 86 34 E. | 12 35 | Sun's true altitude | 12 42 | | |

| | ° ′ | | |
|---|---|---|---|
| Sun's true altitude ... | 12 42 | Secant ... | 0.01076 |
| Latitude ..... | 36 18 | Secant ... | 0.09370 |
| Polar distance ..... | 76 48 | | |
| Sum ..... | 125 48 | | |
| Half-sum ..... | 62 54 | Co-sine... | 9.65853 |
| Remainder ..... | 13 54 | Co-sine... | 9.98709 |
| | | | 2)19.75008 |
| | 48 35 | Sine..... | 9.87504 |
| | 2 | | |
| True azimuth.....N. | 97 10 E. | | |
| | 180 | | |
| Or S. | 82 50 E. | | |
| Magnetic azimuth.....S. | 86 34 E. | | |

Variation 3 44 East, the true azimuth being to the *right* of the magnetic.

## EXAMPLES FOR EXERCISE.

1. March 8, 1835, in latitude 12° 36′ S., and longitude 155° 30′ E., at 6h. 36m. P. M., apparent time, the sun's magnetic azimuth was observed to be S. 79° 15′ W., at the same time the altitude of his lower limb was 9° 46′; the height of the observer's eye being 16 feet, and the error of the instrument + 3′ 30″: required the variation of the compass.

Answer. 7° 41′ East.

2. August 6, 1835 (civil time), in latitude 18° 27′ S., and longitude 5° 32′ W., at 7h. 44m. A. M., apparent time, the sun's magnetic azimuth was observed to be N. 81° 40′ E., when the altitude of his lower limb was 17° 49′; the height of the observer's eye being 22 feet, and the error of the instrument + 3′ 45″: required the variation of the compass.

Answer. 17° 11′ West.

3. May 21, 1835, in latitude 52° 12′ N., and longitude 165° 40′ E., when a chronometer shewed 17h. 56m. 34s., May 20, mean time at the meridian of Greenwich, the sun's azimuth, by compass, was observed to be S. 82° 58′ W.; the altitude of his lower limb being at the same time 23° 48′ 30″, and the height of the observer's eye 12 feet: required the variation of the compass.

Answer. 9° 16′ East.

4. September 1, 1835 (civil time), in latitude 31° 20′ S., and longitude 33° 12′ W., when a chronometer shewed 17h. 48m., August 31, mean time at Greenwich, the altitude of the sun's lower limb was 15° 2′, and his magnetic azimuth N. 69° 48′ E.; the height of the observer's eye being 21 feet, and the index error — 2′ 30″: required the variation of the compass.

Answer. No variation.

# ON HADLEY'S SEXTANT.

This Instrument is constructed on the same principles as the quadrant; but as it is used to measure the *angular* distance between the moon and the sun, a star, or a planet, in order to determine the longitude, the arch is extended to 120 degrees, for the purpose of measuring their distance when greater than 90 degrees: it is also provided with some appendages not commonly annexed to a quadrant, in order to take the observations with greater accuracy; which will be described in the following pages.

Fig. I. Plate IX. represents a Sextant, the frame of which is sometimes made of ebony, but generally of brass, or other hard metal. The arch AA is, on the common instruments, made of ivory, and divided into 120 degrees, each degree into 3 parts, of course equal to 20 minutes, which is again subdivided by the nonius into half-minutes, or 30 seconds, each second-division, or minute, on the nonius, being cut longer than the intermediate ones. The nonius is numbered at every fifth of these longer divisions, from the right towards the left, with 5, 10, 15, and 20; the first division towards the right-hand, marked 0, being called the *index division*.

But the best sextants, which have metal arches, are usually divided to quarter minutes; in which case the degrees on the arch are divided into 4 equal parts, or 15 minutes; and the minutes on the nonius into the like number, each equal to 15 seconds.

On some sextants the degrees are divided into six equal parts, each representing 10 minutes; and the minutes on the nonius also into six parts, or 10 seconds each. The nonius is sometimes placed above, and sometimes below the arch.

Figure 8 represents part of the arch of a sextant, the degrees of which are divided into 4 equal parts, and the minutes of the nonius scale into the like number. In this figure the index division, or 0 of the nonius, which is placed above the arch, stands between 25° 15′ and 25° 30′ on the arch: and that division of the nonius exactly coinciding with one on the arch, is the second, or 30″ to the left of 7 minutes, or 7′ 30″, therefore the whole extent between the index division and the 0 on the arch is 25° 22′ 30″.

Again, in figure 9, where the nonius is below the arch, the 0 on the nonius is somewhat more than three divisions, or 30′, to the left of 56°; and the division on the nonius, coinciding with one on the arch, is 5′, therefore the angle pointed out by the index division is 56° 35′.

When the index division is to the right of 0 in the arch, or as it is called on the *arch of excess*, the divisions are to be counted from left to right, both on the arch and on the nonius; thus, suppose on an instrument divided as in figure 8, the 0 on the nonius was rather more than three divisions to the right of 0 on the arch, and that the third long division on the nonius (representing minutes) from the left, marked 15, coincided exactly with a division on the arch, then the whole arch would be 48 minutes, that is 45 minutes on the arch of excess, and 3 minutes on the nonius.

# HADLEY'S SEXTANT.

Fig. 2.

Fig. 3.

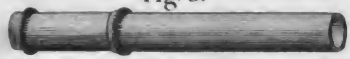


Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.



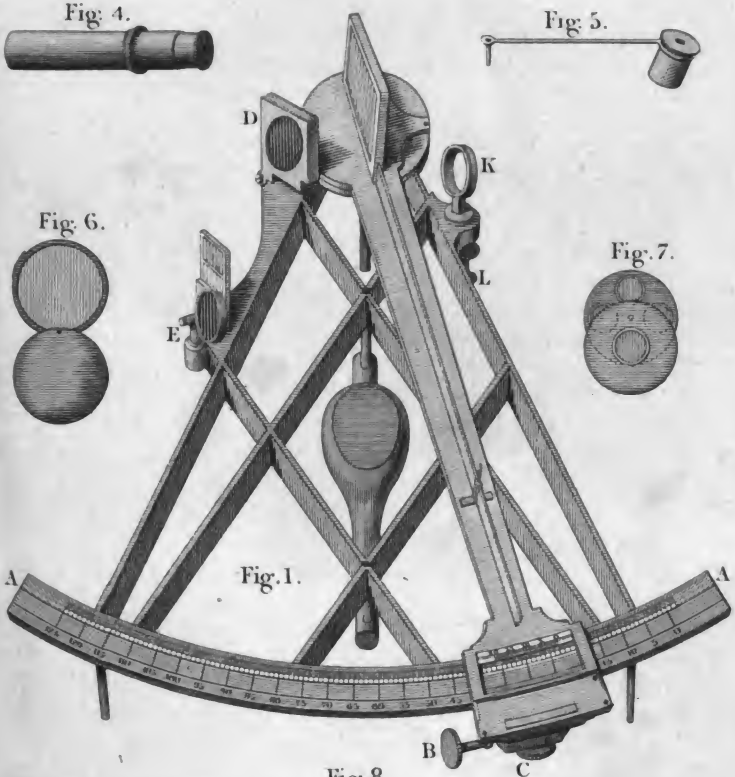



Fig. 1.

Fig. 8.

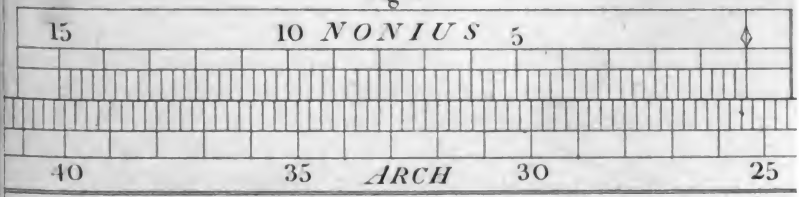
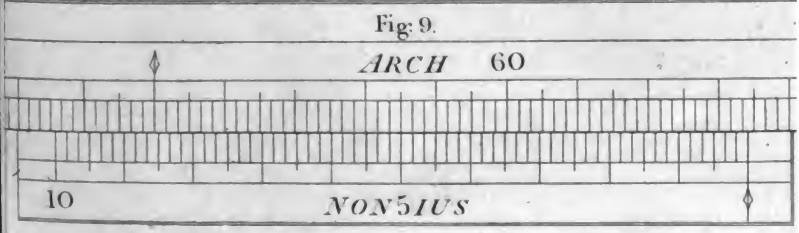



Fig. 9.



Or if the 0 on the nonius of a sextant, divided as in figure 9, were placed between the third and fourth divisions to the right of 0 on the arch, and the fifth subdivision on the nonius, counting to the right from that marked 10, coincided with one on the arch, the whole arch would be 30 minutes and 50 seconds.

In order to observe with accuracy, and make the images come precisely in contact, an adjusting, or *tangent screw* B, is added to the index, by which it may be moved with greater regularity than it can be by hand; but it must be observed, this screw does not act until the index is fixed by the clamp or finger screw C, placed at the back of the sextant. Care should be taken not to force the tangent screw when it arrives at either extremity of its arch. When the index is to be moved any considerable quantity, the screw C must be loosened; but when the index is brought nearly to the division required, this back screw should be tightened, and then the index be moved gradually by the tangent screw.

Four shades, or coloured glasses, are placed at D, between the index and horizon-glasses, each of which is set in a different frame, turning on a centre: they are used to screen the eye from the brightness of the reflected solar image, and the glare of the moon, and may be used separately, or together, as occasion requires.

Three more such glasses are placed behind the horizon-glass at E, to weaken the rays of the sun or moon, when they are viewed directly through the horizon-glass. The pale glass is sometimes used in observing altitudes at sea, to take off the strong glare of the horizon.

The sextant is generally furnished with a plane tube (Fig. 2) without any glasses; and to render the objects still more distinct, it has likewise two telescopes, one representing the objects *erect*, or in their natural position (Fig. 4); the other, a longer one (Fig. 3), which shews the objects *inverted;* but the latter has a larger field of view, and a greater magnifying power, with other advantages: a little use will soon accustom the observer to the inverted position, and the instrument will be as readily managed by it, as the plane tube alone. By a telescope the contact of the images is more perfectly distinguished; and by the place of the images in the field of the telescope, it is easy to perceive whether the sextant is held in the proper plane for observation. By sliding the tube that contains the eye-glasses in the inside of the other tube, the object is suited to different eyes, and made to appear perfectly distinct and well defined.

The telescope is to be screwed into a circular ring at K: this ring rests on two points, against an exterior ring, and is held thereto by two screws; by turning one, and tightening the other, the axis of the telescope may be set parallel to the plane of the sextant, as already directed. The exterior ring is fixed on a brass stem that slides into a socket; and by means of the screws at the back of the sextant, it may be raised or lowered, so as to move the centre of the telescope to point to that part of the horizon-glass which shall be judged the most fit for observation.

A circular head, with coloured glasses (Fig. 7), sometimes accompanies the sextant, and is to be screwed on the eye-end of the tube, or on that of either telescope. The glasses are contained in a circular plate, which has

four holes; three of these are fitted with coloured glasses, the fourth is open. By pressing the finger against the projecting edge of this circular plate, and turning it round, the open hole, or any of the coloured glasses, may be brought between the eye-glass of the telescope and the eye.

To these appendages are added a small screw-driver, to adjust the screws; a magnifying-glass (Fig. 6), to read off the observation with greater accuracy; and a microscope (Fig. 5), for the same purpose, made to fit into a tube fixed at the lower end of the index.

## ADJUSTMENTS OF THE SEXTANT.

To adjust a sextant is to set the index and horizon-glasses perpendicular to the plane of the instrument, and their planes parallel to each other when the index-division is at 0 on the arch; also, to set the axis of the telescope parallel to the plane of the instrument: each of these particulars must be examined before an observation is taken, and the adjustments, if requisite, made according to the following directions.

I. *To set the Index-Glass perpendicular to the Plane of the Sextant.*

Move the index forward to about 60 degrees; then, holding the instrument horizontally, with the limb from the observer, look obliquely down the index-glass, and see if the reflected and the true arches appear to be in the same plane; if they are, the glass is adjusted; otherwise, it is to be rectified by the screws behind the glass, as directed for the quadrant, page 176.

II. *To set the Horizon-Glass perpendicular to the Plane of the Sextant.*

Screw on the plane tube, or the common telescope, and, holding the sextant horizontally, observe if the reflected and true horizons appear in the same strait line; if they do, the glass is adjusted; otherwise, turn the screw at the back of the instrument till they perfectly coincide. This adjustment may also be made by directing the telescope to the sun, moon, or a star, in which case make the index-division, or 0 on the nonius, coincide with 0 on the arch; then, holding the instrument perpendicularly to the horizon, direct the telescope to the object; if the reflected image be to the right or left of the direct object, turn the screw under the horizon-glass till they coincide with each other, when the glass will be perpendicular to the plane of the instrument. If the adjustment be made by a star, move the index backwards and forwards slowly, and observe if the reflected image, in passing the star, coincide with it; if it does not, the glass is to be adjusted by the screw, as before.

Horizon-glasses are fitted up in various ways, to admit of this adjustment. In some sextants a screw, connected with the brass frame of the horizon-glass, which moves on two points, is placed behind, over which a brass cap is screwed, to secure it from accidents; in others, a small screw is placed at the top of the frame, and is moved by a steel lever pin: by means of these screws the horizon-glass is set perpendicular to the plane of the instrument.

When this or the following adjustment is made by observing the sun, the inverting telescope is always to be used, and one or more of the shades, both before and behind the horizon-glass, are to be turned up, in order to screen the eye from the bright solar rays proceeding from the direct and reflected suns; which are to be made, by means of the shades, to appear as nearly as possible of the same degree of brightness.

III. *To set the Horizon-Glass parallel to the Index-Glass, when the Index Division is at* 0 *on the Arch.*

Make the index division of the nonius coincide exactly with 0 on the arch; and, in order to make the coincidence as perfect as possible, examine them through the magnifying glass, or microscope, and fix the index by the clamp under it; screw on the telescope, and turn the screw L, at the back of the instrument, till the line which separates the transparent and silvered parts of the horizon-glass, bisect the field of the telescope. Having done this, hold the sextant perpendicularly, and direct the sight through the telescope to the horizon; then, if the reflected and true horizons do not coincide, turn the tangent screw at the back of the horizon-glass till they be made to appear in the same strait line: then will the planes of the horizon and index-glasses be parallel.

This adjustment, in some instruments, is made by means of two screws placed near the horizon-glass, which act against each other in turning the frame round its axis: these screws are moved by a steel lever-pin, put into one of the holes made through the head of the screw; and in making the adjustment by these screws, care must be taken, that when one is slackened, the other must be tightened, in order that they may sufficiently press against each other, and prevent the horizon-glass from altering its position, when the direct and reflected horizons are made to coincide. But although the adjustment made by these screws is not so liable to alter as when made by a tangent screw, it is recommended not to depend on this adjustment, but rather to find the *index error;* and indeed this becomes absolutely necessary when the horizon-glass is so constructed as not to admit of the adjustment, which is the case with most modern instruments.

*To find the Index Error.*

The *index error* is the number of minutes and seconds pointed out by the nonius, when the direct object and its reflected image coincide with each other, and may be found as directed in the adjustment of the fore horizon-glass of the Quadrant, in page 177; but with greater accuracy by the following method:—

Having screwed on the inverting telescope, adjusted the eye-tube to distinct vision, and turned up the proper shades, place the 0 on the nonius about 40 minutes to the *right* of 0 on the arch, and tighten the clamp C under the index of the sextant; then, holding the instrument perpendicularly, bring the direct and reflected suns in exact contact by the tangent screw, and read off the minutes and seconds pointed out by the nonius on the *arch of excess*, which note down, and call it *off;* next place the 0 of

the nonius about 40 minutes to the *left* of 0 on the arch, and make the contact of the two suns correct, as above; read the minutes and seconds shewn by the nonius, which call *on*, and set it under the first arch; then half the difference of these two arches will be the index error, which is *additive* to all angles taken with the sextant, when the arch to the right of 0 is greater than the arch to the left of 0, and *subtractive* when the contrary. The direct and reflected suns will appear through the inverted telescope thus—

When the index-division is to the right of 0 on the arch.

When the index-division is to the left of 0 on the arch.

Suppose the following observations were taken, to determine the index error:

EXAMPLE I.

| | | ′ | ″ |
|---|---|---|---|
| Off..... | + | 31 | 45 |
| On..... | − | 33 | 0 |
| | | 2) 1 | 15 |
| | − | 0 | 37 |

Index error 0′ 37″ subtractive, because the arch to the left, or *on*, is greater than the arch to the right of 0.

EXAMPLE II.

| | | ′ | ″ |
|---|---|---|---|
| Off..... | + | 32 | 10 |
| On..... | − | 31 | 20 |
| | | 2) 0 | 50 |
| | + | 0 | 25 |

Index error 25″ additive, because the arch to the right, or *off*, is greater than the arch to the left of 0.

To prove that the contacts were made correctly, add the arches together, and divide their sum by 4; the quotient should then be equal to the sun's semidiameter, as given in Page II. of the given month in the Nautical Almanac: Thus, suppose the observations in Example I. were made on February 12th, 1835: here the sum of the arches is 64′ 45″, the fourth part of which is 16′ 11″, agreeing nearly with the sun's semidiameter (16′ 13″) as given on that day in the Nautical Almanac; it may therefore be presumed that the contacts were correctly made.

But if the altitude of the sun should be less than about 20° at the time of taking the above observations, the sun's horizontal, instead of the perpendicular, diameter should be measured; for as refraction affects the lower limb more than the upper, it occasions the perpendicular diameter to be less than the horizontal, which is that given in the Nautical Almanac: in this case, the sextant is to be held horizontally, with the face upwards, and the reflected sun brought into contact alternately with the right and left limbs of the direct sun, as before explained; the contacts will then appear thus—

Reflected sun. Direct sun.

Direct sun. Reflected sun.

### IV. *To set the Axis of the Telescope parallel to the Plane of the Sextant.*

In measuring angular distances, the line of sight, or axis of the telescope, should be parallel to the plane of the instrument, as a deviation in that respect may occasion a considerable error in the observation, and this is most sensible in large angles; to avoid which, a telescope is made use of, in whose field there are placed two wires parallel to each other, and equidistant from the centre, to which are generally added two others at right angles to these, and parallel to each other. By means of these wires, the adjustment may be made thus: screw on the telescope, and turn the tube containing the eye-glass till two of the wires are parallel to the plane of the instrument; then take two objects, as the sun and moon, or the moon and a star, or two stars, whose angular distance must not be less than 90 degrees, because the error is more easily discovered when the distance is great: bring them exactly into contact at the wire which is nearest the plane of the sextant, and fix the index; then, by altering a little the position of the instrument, make the objects appear on the other wire. If the contact still remain perfect, the axis of the telescope is in its right situation; but if the limbs of the two objects appear to separate at the wire that is farthest from the plane of the instrument, it shews that the object-end of the telescope inclines towards the plane of the instrument, which must be rectified by tightening the screw nearest the sextant, which is attached to the ring that holds the telescope, having previously slackened the screw farthest from it. If the images overlap each other at the wire farthest from the sextant, the object-end of the telescope is inclined from the plane of the sextant, and the highest screw must be turned towards the right, and the lowest towards the left. By repeating this observation a few times, the contact will be precisely the same at both wires, and consequently the axis of the telescope will be parallel to the plane of the instrument.

## USE OF THE SEXTANT.

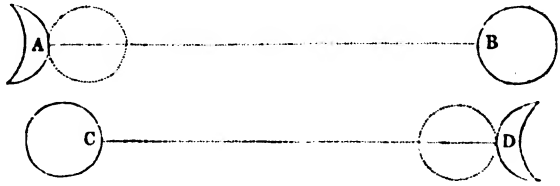
### *To observe the angular Distance between the Moon and the Sun.*

Turn up one or more of the shades before the horizon-glass, according to the brightness of the sun, and set the index division to 0 on the arch; then, holding the plane of the sextant so as to pass through the two objects, with its face upwards, when the sun is to the right-hand of the moon, or downwards, when the sun is to the left (see Diagrams in the following page), direct the sight through the ring K and the horizon-glass, to the moon, without using the telescope, and move the index forward until the sun's image come nearly in contact with the moon's nearest limb; then fix the index by the screw C under the sextant. Now screw on the *inverting* telescope, adjusted to distinct vision, placing two of the wires parallel to the plane of the instrument, and raising the telescope, by the screw L, to the transparent part of the horizon-glass; then, directing the sight through the telescope to the moon, holding the sextant as before directed, make the contact perfect by

means of the tangent screw B; at the same time moving the sextant slowly round the axis of the telescope, by which means the sun will appear to pass by the moon, and the contact be more accurately made; observing always, that the point of contact of the limbs should be as near the centre of the field of the telescope as possible.

The arch pointed out by the nonius being now read off, as before directed, will shew the observed distance of the nearest limbs of the sun and moon.

In the following Diagrams, A B represent the observed distance of the nearest limbs when the sun is to the right of the moon, and C D the distance when the sun is to the left of the moon.




It will perhaps be more easy for those who are not accustomed to take observations, to find the distance nearly, and setting the index forward to it, to look directly towards the moon, holding the instrument as before; the sun will then appear nearly in contact with it, and is to be made perfect by the method above mentioned. In the Nautical Almanac, the distances of the sun and moon are set down for the beginning of every third hour of time at Greenwich, on such days as the moon is not less than 35 degrees, nor more than 125 degrees from the sun, and may be found for any intermediate time by proportion. From these distances you may compute roughly their distance at the time of observation, thus: calculate roughly the time at Greenwich, when the observation is to be taken, as directed in Page 155; then find by the Ephemeris the distance nearly at that time, from which subtract 30 minutes, the sum of the semidiameters, and the remainder will give the distance of their nearest limbs at the time of observation.

It will save some trouble, and serve the purpose of finding the reflected image of the sun or moon in the horizon-glass, if you only set the index to the central distance, as set down in the Almanac for the nearest third hour, without correcting it to the intermediate time by a rough computation.

*To observe the Distance between the Moon and a Star or Planet.*

Turn up one of the lightest screens before the horizon-glass, and, without the telescope, direct the sight through the ring K, and the horizon-glass, to the star; holding the sextant in such a direction that if its plane be seen edgewise, it may appear to pass through the moon and the star, with its face upwards or downwards, according as the st r is to the left or right of the moon; then move the index forward, until the reflected image of the moon be seen near to the star. Now screw on the inverting telescope, and adjust it as before directed; bring the *enlightened* edge of the moon into contact with the star, by means of the tangent screw, at the same time moving the

arch of the sextant slowly up and down, by which motion the enlightened limb of the moon will appear to pass the star, and the contact be more accurately made, which should always be as nearly as possible to the centre of the field of the telescope. The arch being then read off, will give the observed distance between the star and the moon's enlightened limb.

In the following Figure, A B represent the distance of the star at A from the moon's nearest limb at B, and B C the distance of the moon's furthest limb from the star at C.

If the distance between the moon and one of the stars set down in the Almanac, for finding the longitude, is to be observed, their distance may be roughly calculated, as before directed, to which set the index; then look through the telescope, and direct the sight to the star; which is generally a bright one, and lies in a line nearly perpendicular to the horns of the moon, either to the eastward or westward, as denoted in the Almanac; and, holding the sextant in the plane of the two objects, give it a slow motion round the axis of the telescope, and if the moon's image come into the field of the telescope, it is a proof you have taken the right star, as no other in that direction will correspond to it in distance.

In this manner the distance of the moon from a planet is to be observed; but the moon's enlightened limb is always to be brought over to the *centre* of the planet.*

## ON THE ARTIFICIAL HORIZON.

When altitudes are to be taken on shore with a sextant, where the observer has not the advantage of the sea horizon, he is obliged to have recourse to an artificial horizon, which is a horizontal plane with a smooth or polished surface, on which the rays of the sun, or other object, falling, are reflected back to an eye placed in a proper position to receive them: the angle between the real and reflected objects being then measured with a sextant, will be double the altitude above the horizontal plane.

Such a horizontal plane may be obtained by pouring a quantity of oil, tar, treacle, or other fluid and viscous substance, into a shallow vessel; and, to prevent the wind giving a tremulous motion to its surface, a piece of thin gauze, muslin, or plate-glass, whose surface is perfectly plane and parallel, may be placed over it when used for observation.

* A star is a new luminous point, having no sensible diameter; but that of a planet amounts to a few seconds. If the distance be taken as directed above, the necessity of allowing for the planet's semidiameter will be avoided in clearing the distance.

An artificial horizon sometimes consists of a plane speculum, fixed in a brass frame, standing upon three adjusting screws, by which its surface may be made horizontal with the assistance of a spirit-level placed on its surface in various positions; observing that the screws be turned until the air-bubble always rests in the middle of the tube. The under surface of the plate of glass is sometimes unpolished and blackened, so that the image of the sun can only be reflected from the upper surface, which should be carefully polished, and a perfect plane: by this means the errors that might arise from a defect of parallelism in the two surfaces are avoided.

But the best and most approved kinds of artificial horizons are those produced by quicksilver, which being poured into a small wooden trough, will always, agreeably to the nature of fluids, preserve an exact horizontal plane at its surface: over this is placed a roof, to protect the quicksilver from the action of the wind; in which are fixed two plates of glass, the two sides of each being ground perfectly plane and parallel. These are usually packed in a mahogany box, with a vessel containing a quantity of quicksilver, ready for use when wanted.

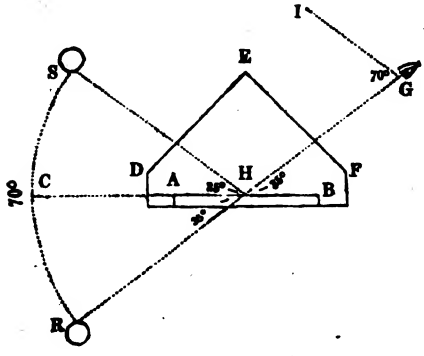
When one of these instruments is used, the observer is to place himself at a convenient distance, for instance, two or three feet, in such direction as that he may see the object reflected from the artificial horizon, as well as the real object; then, having screwed on the telescope of the sextant, and turned down the dark glasses before and behind the horizon-glass, the upper or lower limb of the sun's image, reflected from the index-glass, is to be brought into contact with the opposite limb of the image reflected from the artificial horizon, observing that when the inverted telescope is used, the upper limb will appear as the lower, and *vice versâ**: the angle on the instrument being then read off, and the index error applied to it, will give double the altitude of the limb above the horizontal plane; to the half of which, if the refraction, parallax, and semidiameter be applied, the result will be the true altitude of the centre.

EXAMPLE. Suppose, August 12, 1835, the observed angle between the lower limb of the sun, reflected from the index-glass of the sextant, and the upper limb reflected from the artificial horizon, to be 99° 45′ 30″, the index error of the sextant being 2′ 20″ to add: required the true altitude of the sun's centre.

| | ° | ′ | ″ |
|---|---|---|---|
| Observed angle | 99 | 45 | 30 |
| Index error | + | 2 | 20 |
| 2) | 99 | 47 | 50 |
| Observed altitude of sun's lower limb | 49 | 53 | 55 |
| Refraction—Parallax (Table XVIII.) | — | | 42 |
| True altitude of sun's lower limb | 49 | 53 | 13 |
| Sun's semidiameter | + | 15 | 49 |
| True altitude of sun's centre | 50 | 9 | 2 |

* It will perhaps be more easy to the observer, if he first bring the images of the sun nearly into contact by the naked eye, and afterwards screw on the telescope, and make the contact perfect by the tangent-screw.

The following diagram will illustrate the method of observing altitudes with an artificial horizon:




Let A B represent the surface of the quicksilver, contained in a wooden trough, whose plane is continued to C; D E F, the roof, in which are fixed two plates of glass, D E and E F, whose surfaces are plane and parallel to each other; and ○ the sun at S., whose altitude is required. Now the ray S H, proceeding from the sun's lower limb to the surface of the quicksilver, will be reflected thence to the eye, in the direction H G, and the upper limb of the sun's image, reflected from the quicksilver, will appear in the line G H, continued to R; and it is a well-known principle in catoptrics, that the angle of incidence S H A or S H C, is equal to the angle of reflection G H B; and as the angle A H R or C H R is vertical, or opposite to the angle G H B, it is therefore equal to it, and to the angle S H C: consequently the angle S H R is double the angle S H C, the altitude of the sun's lower limb above the horizontal plane; so that if we suppose the angle S H R, measured by a sextant, to be 70°, the altitude of the sun's lower limb will be 35°.

In theory, the eye of the observer should be placed at the angular point H; but as a ray I G, proceeding from so distant an object as the sun to the eye at G, may be considered as parallel to the ray S H, the measured angle I G H will be equal to the angle S H R.

## ON FINDING THE

# LONGITUDE BY OBSERVATION.

Various methods have been proposed for determining the longitude of a place, but almost all of them depend upon one general principle, *viz.* the comparison of the relative times under two different meridians; so that if the time under a given meridian be known, and also the time under any other meridian, the difference of these times, turned into degrees and minutes, in the proportion of 15 degrees to 1 hour, will be the difference of longitude between the two meridians. For as the sun apparently moves round the earth, from east to west, in 24 hours, or over an arch of 15 degrees of the equator in 1 hour of time, all places lying to the eastward of any meridian, will have noon sooner, or if to the westward, later, by as much time as the sun takes to pass from the meridian of one place to the meridian of the other: hence, if the time at the meridian of Greenwich (from whence the longitude is reckoned), and of any other place, at the same moment of

absolute time, be given, its longitude from Greenwich may be inferred by reducing the difference of the times into degrees and minutes, in the proportion of 15 degrees of longitude to 1 hour of time: moreover, if the time at the place be greater than that at Greenwich, its longitude will be east, but if less, it will be west. Thus, suppose it is ascertained that the time at Greenwich is 2 hours past noon when it is just noon at the ship; it will thence appear that the longitude of the ship is 30° west of the meridian of Greenwich, because the sun passes over 30° of the equator in 2 hours of time, and having left the meridian of Greenwich 2 hours since, the ship must consequently be to the westward of that meridian. If we suppose the time at the ship to be 2 hours past noon when it is noon at Greenwich, her longitude would be 30° east of the meridian of Greenwich; for the sun in this case would have passed the meridian of the ship 2 hours before he passed that of Greenwich.

Now the time at any given meridian may be easily computed by an altitude of the sun or other celestial object, taken when distant from the meridian, or from observations of the sun when at equal altitudes; and the time at Greenwich may be ascertained by means of a chronometer, or by various astronomical observations. With respect to the first of these, it is obvious that if a clock or watch could be so constructed as to go uniformly in all seasons, and at all places, such a machine being once set to mean time at Greenwich, would always shew the mean time at that meridian, on whatever part of the earth it might be; and therefore, if the mean time under any other meridian were found, and compared with that shewn by the chronometer, the longitude of the place from Greenwich would be readily obtained. To effect this purpose, several ingenious artists have exerted their abilities, and have brought chronometers to an astonishing degree of perfection, whereby they have become a valuable acquisition to the navigator, in determining the difference of longitude made in short periods: however, considering the delicacy of their construction, and the various accidents to which they are liable, an implicit confidence ought not to be placed on them alone, particularly in long voyages; but recourse should be had to astronomical observations, whenever opportunities present themselves.

The various astronomical methods of determining the longitude depend likewise upon the above-mentioned general principle; for, by observing the time at the meridian of a given place when any celestial appearance happens, and comparing the same with the time at Greenwich, as shewn by the Nautical Almanac*, their difference, reduced to degrees and minutes, gives

* The Nautical Almanac was originally proposed by the late Dr. Maskelyne, Astronomer Royal, and the first published was for the year 1769, by order of the Commissioners of Longitude; being constructed, calculated, and printed under the immediate inspection of Dr. M., and after his decease, continued annually, with additions, by Mr. Pond, the present Astronomer Royal, till the year 1833.

In 1834, this most important and useful Work, so essential to the Navigator and Astronomer, was published by order of the Lords Commissioners of the Admiralty, according to an improved plan, recommended by a Committee of the Astronomical Society; and is now conducted under the superintendence of Lieutenant W. S. Stratford, of the Royal Navy.

All the calculations in the New Nautical Almanac are set down for *mean time*, at the meridian of Greenwich, excepting those in Page I. of each month, which are computed for *apparent time*. In the latter part of the Work is given a clear and copious explanation of all the articles contained therein, which renders any further explanation here unnecessary.

the longitude of the place where the observation is taken. Suppose, for instance, that an eclipse of the moon should be observed at a certain place to begin at midnight, and that by the Almanac, the time at Greenwich, when the eclipse commenced, was 3 hours past midnight: now as the commencement of the eclipse must be seen at the same moment of absolute time in all parts where it is visible, the difference between the time at the place of the observer and that of Greenwich, which is 3 hours, and answers to 45 degrees, must be the longitude of the place; and it is evidently west, because the time at the place is less than the time at Greenwich. Upon the same principle the eclipses of Jupiter's satellites will give the longitude. But eclipses of the moon happen too seldom to be of use at sea; and the satellites of Jupiter are visible only through a telescope of considerable magnifying powers, which cannot be managed on board a ship.

The most practical method of ascertaining the time at Greenwich by celestial observations taken at sea, is that of measuring the angular distance between the moon and sun, or the moon and certain stars or planets near the ecliptic, usually called a *lunar observation*, both on account of the quick motion of the moon in her orbit, and the frequent opportunities that offer for taking such observations; for in favourable weather, distances may be taken at all times when the objects are more than 9 or 10 degrees above the horizon, except about the time of new moon; and, as the moon's daily motion is about 13 degrees, or at the rate of 1 minute of a degree in two minutes of time, if her true angular distance from the sun, a star, or a planet can be ascertained within 30″ of a degree, the corresponding time at Greenwich will be known within one minute of time, and hence the longitude within 15 minutes of a degree.

This method of determining the longitude was proposed many years ago by Mr. John Werner and others; but, from want of proper instruments to observe the distances, and of a good lunar theory to ascertain the moon's place, it was laid aside. These difficulties are, however, now happily obviated by the invention and improvements of Hadley's Sextant, and the accuracy of the new Lunar Tables; so that a good observer, with proper instruments, may depend upon the longitude found by this method within a few minutes of a degree.

To facilitate this important problem, the true angular distances between the centres of the moon and the sun, a fixed star, or planet,* are set down in Pages XIII. to XVIII. of each month in the Nautical Almanac, for the beginning of every third hour of Greenwich mean time; and the time answering to any intermediate distance, may be found by proportional parts:

* The Stars used in the Nautical Almanac for the above purposes are, α *Arietis*, *Aldebaran*, *Pollux*, *Regulus*, *Spica Virginis*, *Antares*, α *Aquilæ*, *Fomalhaut*, and α *Pegasi*. As a knowledge of these stars is of great importance to the observer, the Author has published a Set of Celestial Maps, with directions for using them, in which the above stars are particularly pointed out, and may be more readily known by comparing the maps with the heavens, than they possibly can by any verbal description.

The *Planets* from which the moon's distances are computed, are *Venus*, *Mars*, *Jupiter*, and *Saturn*; these distances were formerly published by Professor Schumacher, at Copenhagen, but are now introduced into the new Nautical Almanac, among the other distances, being calculated under the direction of the Professor.

hence the distance between these objects being taken with a sextant or circle, and the corresponding mean time at Greenwich found by the Almanac, and compared with the mean time at the ship, their difference will be the longitude of the place of observation.

But since the observed distance is always taken from the surface of the earth before it is compared with the true distances in the Almanac, it must be corrected, in order to find what it would have been if observed at the centre, to which point the true distances are referred; for, by the effects of parallax and refraction, the moon is seen lower than its true place, and the other objects higher: hence the true is almost always different from the observed distance.

In taking a *lunar observation*, two assistants should be employed to observe the altitudes of the objects, while the principal observer is taking their distance; also one with a watch, to mark the times when the observations were made. If one of the objects be at a proper distance from the meridian, the time may be inferred from its altitude; but if it be too near the meridian, a watch or chronometer will be absolutely necessary, whose error must be found by an altitude taken before or after the lunar observation, according as it is most convenient.

The quadrants and sextant being properly adjusted, and their index errors found, place the assistants in the most convenient situation, and let the one holding the watch be provided with a paper and pencil, to note down the observations when taken. All things being ready, proceed to take the distance between the objects, the assistants at the same time observing the altitudes of each. When this is done, give notice to the assistant with the watch, who is to mark the exact time, and set it down, together with the observations read off from the instruments. In this manner proceed four or five times, each set of observations being noted down in proper order; then take the mean of the times, and of each observation, by adding them together, and dividing their sum by the number of sets observed; the quotient will give the mean of each set, which is much more to be depended upon than if one set only were taken.

The following example will shew the form in which a set of lunar observations are to be written down:

| June ——— | | | | Height of the eye 20 feet. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Times by watch. | | | | Alt. of * Antares. | | | Alt. of ☽'s L. L. | | | Dist. ☽'s far. L. | | | |
| h. | m. | s. | | ° | ′ | ″ | ° | ′ | ″ | ° | ′ | | |
| 9 | 21 | 0 | | 26 | 51 | 0 | 41 | 45 | 30 | 62 | 26 | 53 | |
| | 22 | 20 | | 27 | 0 | 0 | 41 | 33 | 0 | | 26 | 12 | |
| | 23 | 5 | | 27 | 4 | 0 | 41 | 25 | 30 | | 26 | 51 | |
| | 24 | 15 | | 27 | 12 | 0 | 41 | 14 | 30 | | 25 | 14 | |
| | 26 | 0 | | 27 | 24 | 0 | 40 | 58 | 0 | | 24 | 25 | |
| 5) | 116 | 40 | | 135 | 31 | 0 | 206 | 56 | 30 | | 128 | 35 | |
| Means..... | 9 | 23 | 20 | 27 | 6 | 12 | 41 | 23 | 18 | 62 | 25 | 43 | |
| Err. of watch. | + | | 10 | − | 1 | 0 | + | 1 | 15 | − | | 10 | Ind. Errs. |
| | 9 | 23 | 30 | 27 | 5 | 12 | 41 | 24 | 33 | 62 | 25 | 33 | |

It may sometimes happen that, from want of proper assistants, the altitudes of the two objects cannot be taken at the same time with their distance; in

which case the altitudes may be inferred from the apparent time and the latitude of the ship, according to rules laid down for that purpose; but it must be observed, that unless these be well determined, the operation will bring out a considerable error: it will therefore be found much more accurate to adopt the following method, by which one person can take a set of observations without assistants, having a good quadrant to take the altitudes, and a sextant to observe the distances.

Let the observations be taken in the following order, noting the times by a watch: 1, the altitude of the sun, star, or planet; 2, the altitude of the moon; 3, any odd number of distances; 4, the altitude of the moon; 5, the altitude of the sun, star, or planet. Now add together the distances, and the times when they are taken, each of which being divided by the number observed, will give the mean of the times and distances; then, to reduce the altitudes to the mean of the times, say, as the difference of times between the observations is to the difference of their altitudes, so is the difference between the time that the first altitude was taken, and the mean of the times, to a fourth number; which, added to, or subtracted from, the first altitude of each object, according as it is increasing or decreasing, will give the altitudes reduced to the mean of the times.*

## EXAMPLE.

Suppose the following observations were taken at the under-mentioned times: required the altitudes of the sun and moon, reduced to the mean of the times and distances.

| Times per watch. | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3h. 25m. 41s. | Alt. of sun's lower limb..... | 54° | 5′ | 0″ | | | |
| 28 44 | Alt. of moon's upper limb ..... | 20 | 3 | 0 | | | |
| Mean of the times 3h. 33m. 47s. — 32 50 | Dist. nearest limbs..... | 73 | 13 | 30 | Mean dist. 73° 14′ 3″ | | |
| 33 30 | Dist. nearest limbs..... | 73 | 14 | 10 | | | |
| 35 0 | Dist. nearest limbs..... | 73 | 14 | 30 | | | |
| 38 20 | Alt. of moon's upper limb..... | 20 | 45 | 0 | | | |
| 42 4 | Alt. of sun's lower limb..... | 53 | 14 | 0 | | | |

| | Times. | Altitudes. | Times. | |
|---|---|---|---|---|
| 1st alt. | 3h. 25m. 41s. | 54° 5′ | 3h. 25m. 41s. | 1st altitude. |
| 2d alt. | 3 42 4 | 53 14 | 3 33 47 | mean of times. |
| Diff.... | 16 23 | 51 | 8 6 | 0° 25′ 13″ |
| | First altitude of sun's lower limb ..... | | | 54 5 0 |
| | Reduced altitude of sun's lower limb ... | | | 53 39 47 |

| | Times. | Altitudes. | Times. | |
|---|---|---|---|---|
| 1st alt. | 3h. 28m. 44s. | 20° 3′ | 3h. 28m. 44s. | 1st altitude. |
| 2d alt. | 3 38 20 | 20 45 | 3 33 47 | mean of times. |
| Diff.... | 9 36 | 42 | 5 3 | 0° 22′ 6″ |
| | First altitude of moon's upper limb..... | | | 20 3 0 |
| | Reduced altitude of moon's upper limb ... | | | 20 25 6 |

Hence we obtain the following set of observations.

| Time per watch. | Dist. nearest L. of ☉ & ☾. | Alt. of ☉'s L. L. | Alt. of ☽'s U.L. |
|---|---|---|---|
| 3h. 33m. 47s. | 73° 14′ 3″ | 53° 39′ 47″ | 20° 25′ 6″ |

* The change of altitude may be readily found by Proportional Logarithms. See Explanation to Table XXXIV.

## ON FINDING THE TIME AT ANY GIVEN MERIDIAN.

*To find the apparent, or mean Time, at Ship or Place of Observation, and thence the Error of the Watch, by an Altitude of the Sun.*

RULES.—1. With the estimated longitude, and apparent time at ship when the observation is taken, find the corresponding apparent time at Greenwich by the Rule in Page 155, to which apply the equation of time, taken out for the nearest noon from Page I. of the month in the Nautical Almanac, as directed at the head of its column: the result will be the corresponding mean time at Greenwich nearly. Or the Greenwich mean time may be found by a chronometer, whose error for that meridian is known.

2. From the observed altitude of the sun's lower limb subtract the dip of the horizon (V.) and the refraction (IV.), or the difference of refraction and parallax (XVIII.), and to the remainder add the sun's semidiameter, taken from Page II. of the Nautical Almanac; the sum will be the true altitude of the sun's centre. Or the correction for the dip, refraction, and semidiameter may be nearly found at once by Table IX.

3. Take out the sun's declination for the preceding noon at Greenwich, from Page II. of the Nautical Almanac, and correct it for Greenwich mean time by Table XXI. or Table XXXIII.†

4. Take out the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich time by Table LI.

5. Then proceed according to one of the following methods.

### METHOD I.

1. Subtract the sun's declination from 90°, when the latitude and declination are of the same name; or add it to 90° when they are of contrary names; and the sum or remainder will be the sun's polar distance.

2. Add together the sun's true altitude, the polar distance, and the latitude of the place of observation; take the difference between half their sum and the sun's true altitude, and note the remainder:

3. Then add together,
   The co-secant of the polar distance (XXV.);
   The secant of the latitude;
   The co-sine of the half sum;
   And the sine of the remainder.

4. The sum of these four logarithms, rejecting tens in the index, will be the log. (XXXI.), answering to the *apparent time* from the nearest noon: consequently, if the observation be made in the morning, the time thus found must be taken from 24 hours, to obtain the apparent time from the preceding noon.

5. To the apparent time thus found, apply the reduced equation of time, by addition or subtraction, as directed at the head of its column in Page I. of the Nautical Almanac; and the sum or remainder will be the *mean time* at the ship, or place of observation. Hence the error of the watch or chronometer, at the meridian of the place, may be found either for apparent or mean time.

† Or the correction for reducing the declination to Greenwich mean time may be found by the *diff. for* 1 *hour*, in the Nautical Almanac.

## METHOD II.

1. When the sun's declination, and the latitude of the place, are of the same name, take their difference, but when they are of contrary names, take their sum, under which set the sun's zenith distance*; take the sum and difference of these, also the half sum and half difference; then add together,

2. The log. secant of the latitude (XXV.);
The log. secant of the declination;
The log. sine of the half sum;
And the log. sine of the half difference.

The sum of these four logarithms, rejecting tens in the index, will be the log. (XXXI.), answering to the apparent time from the nearest noon, as before.

This method of computing the apparent time will be found very convenient when it is required to work to the nearest second; since the proportional parts to seconds, being all additive, may be added at once with the logarithms, to find the required logarithm.

NOTE. The observations for finding the time should be taken when the sun, or any other celestial object, is at least three hours from the meridian; and the nearer it is to the east or west points of the horizon, the better; because then the change of altitude is quickest, and an error of a few miles in latitude will not materially affect the time†.

It will be proper to observe several altitudes, noting the times, by the watch or chronometer, when each is observed, and to use the means of the sets, which are found by adding the sets together, and dividing their sum by the number that are taken.

## EXAMPLE I.

August 16, 1835, the following observations were made of the sun's lower limb, in latitude 36° 31′ N., and longitude by account 152° E., the height of the observer's eye being 20 feet: required the true apparent and mean time at the ship, and the error of the watch.

| App. Times by Watch. h. m. s. | Altitudes of Sun's L. L. ° ′ |
|---|---|
| 4 40 0 | 24 20 |
| 41 10 | 24 4 |
| 42 5 | 23 50½ |
| 43 0 | 23 36 |
| 44 17 | 23 21½ |
| 5) 210 32 | 119 12 |
| Means 4 42 6 | 23 50 24 |
| Dip of horizon... | − 4 17 |
| | 23 46 7 |
| Corr. (XVIII)... | − 2 0 |
| | 23 44 7 |
| Sun's semidiam. | + 15 49 |
| Sun's true alt... | 23 59 56 |

| | h. m. | | m. s. |
|---|---|---|---|
| App. time at ship, Aug. 16, | 4 42 | Equation of time, August 15 ..... | + 4 20 |
| | 24 | Corr. for 12 hrs. 6s.0 | |
| | 28 42 | Do. for 6h. 38m. 3 .3 | − 9 |
| Longitude in time ..... | 10 8 E. | | |
| Green. app. time, Aug. 15, | 18 34 | Eq. at Greenwich time | + 4 11 |
| Equation of time..... | + 4 | | |
| Greenwich mean time.. | 18 38 | | |

| | ° ′ ″ |
|---|---|
| Sun's declination, August 15, (P. II, N. A.)... | 14 13 36 N. |
| Correction for 12 hours (XXI.)... − 9′ 33″ | |
| Ditto for 6h. 38m. ..... − 5 18 | − 14 51 |
| Sun's declination at Greenwich mean time.... | 13 58 45 N. |
| 90 | |
| Sun's polar distance..... | 76 1 15 |

* The zenith distance is found by subtracting the altitude from 90°.

† The time from noon, or the altitude, when the sun or other celestial object is in the most advantageous position for finding the time at the place of observation, is given in Tables XLV. and XLVI.

## METHOD I.

| | | | | | |
|---|---|---|---|---|---|
| True altitude | 24° 0′ | | | | |
| Polar distance | 76 1 | Co-secant | 0.01306 | | |
| Latitude | 36 31 | Secant | 0.09492 | | |
| Sum | 136 32 | | | | |
| Half sum | 68 16 | Co-sine | 9.56854 | | |
| Remainder | 44 16 | Sine | 9.84386 | | |
| | h. m. s. | | | | h. m. s. |
| Apparent time at ship | 4 41 11 | Log. | 9.52038 | | 4 41 11 |
| Equation of time | + 4 11 | Time by watch | | | 4 42 6 |
| Mean time at ship | 4 45 22 | Watch *fast* for apparent time | | | 0 0 55 |
| Time by watch | 4 42 6 | | | | |
| Watch *slow* for mean time | 3 16 | | | | |

## METHOD II.

| | | | | | |
|---|---|---|---|---|---|
| Latitude | 36°31′ 0″ N. | Secant | 0.094915 | | |
| Sun's declination | 13 58 45 N. | Secant | 0.013033 | | |
| | | | | | 23* |
| Difference | 22 32 15 | | | | |
| Zenith distance | 66 0 4 | | | | 19 |
| | | ° ′ ″ | | | |
| Sum | 88 32 19 | Half 44 16 9 | Sine | 9.843855 | |
| Difference | 43 27 49 | Half 21 43 54 | Sine | 9.568232 | |
| | | | | | 285 |
| | h. m. s. | | | | |
| Apparent time at ship | 4 41 11 | | Log. | 9.52035. | |
| Equation of time | + 4 11 | | | | |
| Mean time at ship | 4 45 22 | | | | |

## EXAMPLE II.

March 15, 1835 (civil time), the following observations of the sun's lower limb were made in latitude 16° 29′ 30″ N., and longitude 99° 30′ W., the height of the observer's eye being 22 feet, and the error of the sextant 2′ 50″ to be subtracted: required the apparent and mean time at the meridian of the ship, and the error of the watch.

| App. Times by Watch. | Altitudes of Sun's L. L. |
|---|---|
| h. m. s. | ° ′ ″ |
| 18 42 52 | 10 28 45 |
| 44 50 | 35 30 |
| 46 44 | 44 15 |
| 3) 134 26 | 108 30 |
| 18 44 49 | 10 36 10 |
| Index error | − 2 50 |
| | 10 33 20 |
| Cor.(IX)+6′.6 | + 6 36 |
| Sun's true alt. | 10 39 56 |

| | h. m. | | m. s. |
|---|---|---|---|
| App. time at ship, Mar. 14, | 18 45 | Equat. of time, March 15 | + 9 15 |
| Longitude in time | 6 38 W. | Correction for 1h. 32m. | − 1 |
| | 25 23 | | |
| | 24 | | |
| App. time at Green. Mar. 15, | 1 23 | Equat. at Greenwich time | + 9 14 |
| Eq. of time (Page I, N. A.). | + 9 | | |
| Mean time at Green. Mar. 15, | 1 32 | | |

| | ° ′ ″ |
|---|---|
| Sun's declination, March 15, (P. II, N. A.) | 2 18 8 S. |
| Correction for 1h. 32m (XXI) | − 1 30 |
| Sun's declin. at Greenwich mean time | 2 16 38 S. |
| | 90 |
| Sun's polar distance | 92 16 38 |

* For the method of finding the proportional parts to seconds, see Explanation to Table XXV.

## METHOD I.

| | | | | | |
|---|---|---|---|---|---|
| | ° | ′ | | | |
| True altitude ..... | 10 | 40 | | | |
| Polar distance..... | 92 | 16½ | .....Co-secant | 0.00034 | |
| Latitude ..... | 16 | 29½ | .....Secant ... | 0.01824 | |
| Sum..... | 119 | 26 | | | |
| Half-sum..... | 59 | 43 | .....Co-sine... | 9.70267 | |
| Remainder ..... | 49 | 3 | .....Sine ..... | 9.87811 | |
| | h. | m. | s. | | |
| Apparent time from noon..... | 5 | 12 | 42.....Log. ..... | 9.59936 | |
| | 24 | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | h. | m. s. |
| Apparent time at ship ..... | 18 | 47 | 18 | ..... | | | 18 | 47 18 |
| Equation of time ..... | + | 9 | 14 | Time by watch ..... | | | 18 | 44 49 |
| Mean time at ship..... | 18 | 56 | 32 | Watch *slow* for apparent time ... | | | | 2 29 |
| Time by watch ..... | 18 | 44 | 49 | | | | | |
| Watch *slow* for mean time ... | | 11 | 43 | | | | | |

## METHOD II.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ″ | | | | | | 19 |
| Latitude ..... | 16 | 29 | 30 | N. | ..... | Secant | 0.018226 | | |
| Sun's declination..... | 2 | 16 | 38 | S. | ..... | Secant | 0.000340 | | |
| | | | | | | | | | 8 |
| Sum ..... | 18 | 46 | 8 | | | | | | |
| Zenith distance ..... | 79 | 20 | 4 | | | | | | |
| | | | | ° | ′ | ″ | | | 11 |
| Sum ..... | 98 | 6 | 12 | Half | 49 | 3 | 6 | Sine ... | 9.878109 |
| Difference..... | 60 | 33 | 56 | Half | 30 | 16 | 58 | Sine ... | 9.702452 |
| | | | | | | | | | 209 |
| | h. | m. | s. | | | | | | |
| Apparent time from noon. | 5 | 12 | 42 | ..... | | | Log. ... | | 9.59937. |

Having found the apparent time from noon, proceed as in the first method, to find the apparent and mean time, and thence the error of the watch.

*To find the apparent and mean Time at Ship or Place of Observation, and thence the Error of the Watch, by an Altitude of a Star.*

RULES.—1. With the estimated longitude and apparent time at ship, or by a chronometer, find the mean time at Greenwich, as directed in the last problem, Page 230.

2. From the observed altitude of the star, subtract the dip (V.) and refraction (IV.), or subtract the correction taken from Table XV., and the remainder will be the star's true altitude.

3. Reduce the star's right ascension and declination (XIII.) to the given year and month,* and the sun's right ascension, taken out for the preceding

* In the Nautical Almanac for 1835, the true *apparent* right ascensions and declinations of the principal fixed stars (that is, their mean places corrected for the effects of precession, aberration, and nutation,) are given, from page 368 to 407, for every day, or tenth day of the month, and may be thence taken, instead of their mean places in Table XIII, in cases where the greatest accuracy is required.

noon from Page II. of the month in the Nautical Almanac, to the mean time at Greenwich (XXII. or XXXIII.)

4. Take out the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich mean time by Table LI.

5. Proceed as with the sun, by either of the methods in the last Problem, to find the hour-angle, or star's distance from the meridian (which, with the sun, is the time from noon); this being added to the star's right ascension, if the star be to the westward of the meridian*, or subtracted from it, if the star be to the eastward, the sum or remainder will be the right ascension of the meridian.

6. From the right ascension of the meridian, increased by 24 hours if necessary, subtract the sun's reduced right ascension; and the remainder will be the apparent time of observation at the meridian of the ship.

7. To the apparent time thus found, apply the reduced equation of time, by addition or subtraction, as directed at the head of its column in Page I. of the Nautical Almanac; and the sum or remainder will be the mean time at the ship, or place of observation. Hence the error of the watch or chronometer, at the meridian of the place, may be found either for apparent or mean time.

## EXAMPLE I.

January 5, 1835, in latitude 18° 21′ N., and longitude by account 55° 45′ West, the following altitudes of the star Procyon were taken, when it was west of the meridian, the observer's eye being 20 feet above the surface of the sea: required the apparent and mean time at the ship, and thence the error of the watch.

| App. Times by Watch. h. m. s. | Altitudes of the Star. ° ′ |
|---|---|
| 16 41 30 | 26 13 |
| 45 10 | 25 14 |
| 48 25 | 24 29 |
| 54 30 | 22 47 |
| 59 13 | 21 17 |
| 5) 248 48 | 120 0 |
| 16 49 45 | 24 0 |

| | h. | m. | s. |
|---|---|---|---|
| Apparent time at ship | 16 | 49 | 45 |
| Longitude in time (XIX) | 3 | 43 | 0W. |
| Apparent time at Greenw. | 20 | 32 | 45 |
| Equation of time, Jan. 6... | + | 6 | 0 |
| Mean time at Greenwich | 20 | 38 | 45 |

| | h. | m. | s. |
|---|---|---|---|
| Sun's R. Ascen., Jan. 5... | 19 | 3 | 0 |
| Corr. for 20h. 39m. (XXII). | + | 3 | 47 |
| Sun's R.A. at Green. time | 19 | 6 | 47 |

| | ° | ′ | ″ |
|---|---|---|---|
| Star's obs. altitude | 24 | 0 | 0 |
| Dip of horizon..... | — | 4 | 17 |
| | 23 | 55 | 43 |
| Refraction ..... | — | 2 | 8 |
| Star's true altitude | 23 | 53 | 35 |

| | m. | s. |
|---|---|---|
| Equation of time, Jan. 5 | 5 | 34 |
| Cor. for 20h. 39m. (LI) | + | 22 |
| Eq. for Greenw. time... | 5 | 56 |

| | h. | m. | s. |
|---|---|---|---|
| Star's right ascension, 1834. (XIII). | 7 | 30 | 37 |
| Annual variation ..... | + | | 3 |
| Star's right ascension, Jan. 1835... | 7 | 30 | 40 |

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Star's declination, 1834. (XIII). | 5 | 38 | 41 | N. |
| Annual variation ..... | — | | 9 | |
| Star's declination, Jan. 1835 ... | 5 | 38 | 32 | N. |
| | 90 | | | |
| Star's polar distance..... | 84 | 21 | 28 | |

* The time of the principal stars passing the meridian, will be found in Table XLIV.

## METHOD I.

| | o ′ | | |
|---|---|---|---|
| Star's true altitude | 23 53½ | | |
| Polar distance..... | 84 21½ | .....Co-secant | 0.00211 |
| Latitude ..... | 18 21 | .....Secant ... | 0.02267 |
| Sum ..... | 126 36 | | |
| Half sum ..... | 63 18 | .....Co-sine... | 9.65256 |
| Remainder ..... | 39 24½ | .....Sine ..... | 9.80267 |
| | h. m. s. | | |
| Star's distance from meridian . | 4 26 41 W. | ...Log. ..... | 9.48001 |
| Star's right ascension..... | 7 30 40 | | |
| Right ascension of meridian ... | 11 57 21 | | |
| | 24 | | |
| | 35 57 21 | | |
| Sun's right ascension..... | 19 6 47 | | |

| | h. m. s. | | h. m. s. |
|---|---|---|---|
| Apparent time at ship ..... | 16 50 34 | ..... | 16 50 34 |
| Equation of time ..... | + 5 56 | Time by watch..... | 16 49 45 |
| Mean time at ship..... | 16 56 30 | Watch *slow* for apparent time | 0 49 |
| Time by watch ..... | 16 49 45 | | |
| Watch *slow* for mean time ... | 6 45 | | |

## EXAMPLE II.

April 22, 1835, in latitude 42° 14′ N., when a chronometer, which was 5m. 16s. too fast for Greenwich mean time, shewed 9h. 8m. 46s., the observed altitude of the star Arcturus, eastward of the meridian, was 36° 54′; the error of the instrument being + 3′ 0″, and the height of the observer's eye 24 feet: required the apparent and mean time at ship, and thence the error of the chronometer.

| | h. m. s. | | h. m. s. |
|---|---|---|---|
| Mean time by chronometer | 9 8 46 | Sun's right ascension, April 22..... | 1 57 49 |
| Chronometer too fast ..... | — 5 16 | Correction for 9h. 3m. (XXII)..... | + 1 24 |
| Mean time at Greenwich... | 9 3 30 | Sun's R. Ascen. at Greenw. mean time | 1 59 13 |
| | o ′ | | h. m. s. |
| Star's observed altitude ..... | 36 54 | Star's right ascens., Jan. 1834 (XIII.) | 14 8 6 |
| Index error ..... | + 3 | Ann. variation + 2s. 73 × 1½ = ..... | + 4 |
| | 36 57 | Star's right ascension, April 1835..... | 14 8 10 |
| Correction Table XV..... | — 6 | | |
| | | | o ′ ″ |
| Star's true altitude ..... | 36 51 | Star's declination, Jan. 1834 (XIII.)... | 20 3 2 N. |
| | m. s. | Ann. variation — 18″.96 × 1½ = ... | — 25 |
| Equation of time, April 22 ... | 1 29 | Star's declination, April 1835 ..... | 20 2 37 N. |
| Correction for 9h. 3m. (LI). ... | + 5 | | 90 |
| Equation at Greenwich time... | 1 34 | Star's polar distance ..... | 69 57 23 |

METHOD I.

| | ° | ′ | | | |
|---|---|---|---|---|---|
| Star's true altitude | 36 | 51 | | | |
| Polar distance..... | 69 | 57 | .....Co-secant | 0.02715 | |
| Latitude ..... | 42 | 14 | .....Secant ... | 0.13053 | |
| Sum ..... | 149 | 2 | | | |
| Half-sum..... | 74 | 31 | .....Co-sine... | 9.42644 | |
| Remainder ..... | 37 | 40 | .....Sine ..... | 9.78609 | |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| Star's distance from meridian. | 3 | 51 | 44 E | .....Log..... | 9.87021 |
| Star's right ascension ..... | 14 | 8 | 10 | | |
| Right ascension of meridian ... | 10 | 16 | 26 | | |
| Sun's right ascension ..... | 1 | 59 | 13 | | |

| | h. | m. | s. | | h. | m. | s. |
|---|---|---|---|---|---|---|---|
| Apparent time at ship ..... | 8 | 17 | 13 | ..... | 8 | 17 | 13 |
| Equation of time ..... | − | 1 | 34 | Time by chronometer ..... | 9 | 8 | 46 |
| Mean time at ship ..... | 8 | 15 | 39 | Chronom. *fast* for apparent time.. | | 51 | 33 |
| Time by chronometer ..... | 9 | 8 | 46 | | | | |
| Chronom. *fast* for mean time... | | 53 | 7 | | | | |

*To find the apparent and mean Time at Ship, or Place of Observation, and thence the Error of the Watch or Chronometer, by an Altitude of a Planet.*

RULES.—1. With the estimated longitude and apparent time at ship, or by a chronometer, find the mean time at Greenwich by the Rule in Page 230.

2. From the observed altitude of the planet, subtract the dip (V.) and refraction (IV.), and to the remainder add the parallax in altitude (XLVIII.): the result will be the true altitude of the planet.

3. Take the sun's right ascension from Page II. of the Nautical Almanac, for the preceding noon, and reduce it to the mean time at Greenwich (XXII. or XXXIII.)

4. Reduce the right ascension and declination of the planet, taken from the Nautical Almanac, to the mean time at Greenwich. (See Note at the top of Page 185.)

5. Take the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich mean time (LI.)

6. Proceed as with the sun, by either of the methods given in Pages 230, 231, to find the planet's meridian distance, and thence compute the apparent and mean time at ship, as directed by the Rules for a Star, in Page 234.

EXAMPLE I.

January 10, 1835, in latitude 22° 16′ N., and longitude by account 34° W., at 6h. 10m. P. M., apparent time by watch, the altitude of the centre of the planet Jupiter was observed to be 55° 10′ 45″ east of the meridian, the height of the observer's eye being 18 feet: required the apparent and mean time at the ship, and from thence the error of the watch.

| | h. m. |
|---|---|
| App. time at ship.... | 6 10 |
| Longitude in time W. | 2 16 |
| App. time at Greenw.. | 8 26 |
| Equation of time .... | + 8 |
| Mean time at Greenw. | 8 34 |

| | ° ′ ″ |
|---|---|
| Jupiter's observed alt. | 55 10 45 |
| Dip of horizon..... | — 4 4 |
| Refraction ..... | 55 6 41 — 40 |
| Par. in alt. (XLVIII) | 55 6 1 + 1 |
| Jupiter's true altitude | 55 6 2 |

| | h. m. s. |
|---|---|
| Sun's R. A., Jan. 10.... | 19 24 52 |
| Cor. for 8h. 34m. (XXII.) | + 1 34 |
| Sun's R. A. at Green. time | 19 26 26 |

| | m. s. |
|---|---|
| Equation of time, Jan. 10 .. | 7 43 |
| Cor. for 8h. 34m. (LI.) .... | + 9 |
| Equation at Greenwich time | 7 52 |

| | h. m. s. | |
|---|---|---|
| Jupiter's R.A., Jan. 10 .. | 4 0 39 | (p. 323 N.A.) |
| Ditto Jan. 11 .. | 4 0 25 | |
| Variation in 24 hours .. | 0 14 | Log. 2. 0122 |
| Greenwich time ..... .. | 8h. 34m. | Log. .4474 |
| Variation in 8h. 34m. .. | — 0 5 | Log. 2. 4596 |
| Jupiter's R.A., Jan. 10, at mean noon ..... | 4 0 39 | |
| Ditto at Greenwich time | 4 0 34 | |

| | ° ′ ″ | |
|---|---|---|
| Jupiter's dec., Jan. 10 .. | 19 53 15 | N. (p. 323 N.A.) |
| Ditto, Jan. 11 .. | 19 52 52 | N. |
| Variation in 24 hours... | 0 23 | Log. 1. 7966 |
| Greenwich time ..... | 8h. 34m. | Log. .4474 |
| Variation in 8h. 34m... | — 0 8 | Log. 2. 2440 |
| Jupiter's dec., Jan. 10, at mean noon .... | 19 53 15 | N. |
| Ditto at Greenwich time | 19 53 7 | N. |
| | 90 | |
| Jupiter's polar distance | 70 6 53 | |

| | ° ′ | | |
|---|---|---|---|
| Jupiter's true altitude .. | 55 6 | | |
| —— polar distance .. | 70 7 | .....Co-secant | 0. 02669 |
| Latitude ..... | 22 16 | .....Secant .. | 0. 03366 |
| Sum ..... | 147 29 | | |
| Half-sum ..... | 73 44½ | .....Co-sine.. | 9. 44711 |
| Remainder ..... | 18 38½ | .....Sine .... | 9. 50467 |

| | h. m. s. | | |
|---|---|---|---|
| Jupiter's meridian distance ..... | 2 29 38 | E.... Log. .... | 9. 01213 |
| —— right ascension ..... | 4 0 34 | | |
| Right ascension of meridian ..... | 1 30 56 | | |
| | 24 | | |
| | 25 30 56 | | |
| Sun's right ascension..... | 19 26 26 | | |
| Apparent time at ship ..... | 6 4 30 | ..... | 6 4 30 |
| Equation of time ..... | + 7 52 | Time by watch..... | 6 10 0 |
| Mean time at ship ..... | 6 12 22 | Watch *fast* for apparent time.... | 5 30 |
| Time by watch ..... | 6 10 0 | | |
| Watch *slow* for mean time..... | 2 22 | | |

## EXAMPLE II.

December 27, 1835, in latitude 10° 12′ S., when a chronometer, which was 2m. 16s. too slow for Greenwich mean time, shewed 6h. 49m. 12s. P.M., the observed altitude of the centre of the planet Venus, westward of the meridian, was 11° 26′ 15″, the error of the instrument being — 2′ 45″, and the height of the observer's eye 24 feet: required the apparent and mean time at the ship, and thence the error of the chronometer for the meridian of the place of observation.

| | h. m. s. |
|---|---|
| Mean time by chron. | 6 49 12 |
| Chronom. too slow . | + 2 16 |
| Mean time at Green. | 6 51 28 |

| | o / // |
|---|---|
| Venus's obs. altitude. | 11 26 15 |
| Index error ..... | — 2 45 |
| | 11 23 30 |
| Dip of horizon..... | — 4 42 |
| | 11 18 48 |
| Refraction ..... | — 4 40 |
| | 11 14 8 |
| Par. in alt. (XLVIII) | + 5 |
| Venus's true altitude. | 11 14 13 |

| | h. m. s. |
|---|---|
| Sun's R. A., Dec. 27 .. | 18 22 9 |
| Cor. for 6h. 51m. (XXII.) | + 1 16 |
| Sun's R. A. at Green. time | 18 23 25 |

| | m. s. |
|---|---|
| Equation of time, Dec. 27.. | 1 9.0 |
| Cor. for 6h. 51m. (LI.).... | + 8.6 |
| Eq. at Greenwich time.... | 1. 17.6 |

| | h. m. s. | |
|---|---|---|
| Venus's R. A., Dec. 27.. | 19 51 19 | (p. 290 N.A.) |
| Ditto Dec. 28.. | 19 56 39 | |
| Variation in 24 hours.... | 5 20 | Log. .6532 |
| Greenwich mean time.... | 6h. 51m. | Log. .5445 |
| Variation in 6h. 51m. .. | + 1 31 | Log. 1.1977 |
| Venus's R. A., Dec. 27, at mean noon..... | 19 51 19 | |
| Ditto at Greenwich time . | 19 52 50 | |

| | o / // | |
|---|---|---|
| Venus's dec., Dec. 27.. | 22 29 45 S. | (p. 290 N.A.) |
| Ditto Dec. 28.. | 22 16 36 S. | |
| Variation in 24 hours .. | 13 9 | Log. .2613 |
| Greenwich mean time .. | 6h. 51m. | Log. .5445 |
| Variation in 6h. 51m. .. | — 3 45 | Log. .8058 |
| Venus's dec., Dec. 27, at mean noon .... | 22 29 45 S. | |
| Ditto at Greenwich time | 22 26 0 S. | |
| | 90 | |
| Venus's polar distance.. | 67 34 0 | |

| | o / | | |
|---|---|---|---|
| Venus's true altitude.... | 11 14 | | |
| —— polar distance .. | 67 34 | .....Co-secant | 0. 03418 |
| Latitude ..... | 10 12 | .....Secant .. | 0. 00692 |
| Sum ..... | 89 0 | | |
| Half-sum ..... | 44 30 | .....Co-sine.. | 9. 85324 |
| Remainder ..... | 33 16 | .....Sine .... | 9. 73921 |
| | h. m. s. | | |
| Venus's meridian distance..... | 5 27 51 | W...Log..... | 9. 63355 |
| —— right ascension..... | 19 52 50 | | |
| R. ascension of meridian + 24 hrs. | 25 20 41 | | |
| Sun's right ascension ..... | 18 23 25 | | |

| | h. m. s. | | h. m. s. |
|---|---|---|---|
| Apparent time at ship ..... | 6 57 16. | ..... | 6 57 16 |
| Equation of time..... | + 1 18 | Time by chronometer ..... | 6 49 12 |
| Mean time at ship ..... | 6 58 34 | Chron. *slow* for apparent time.... | 8 4 |
| Time by chronometer..... | 6 49 12 | | |
| Chronometer *slow* for mean time .. | 9 22 | | |

## *To find the apparent and mean Time at Ship, or Place of Observation, and thence the Error of the Watch or Chronometer, by an Altitude of the Moon.*

RULES. 1. With the estimated longitude and apparent time at ship, or by a chronometer, find the mean time at Greenwich by the Rules in Page 280.

2. From the observed altitude of the moon's upper or lower limb, compute the true altitude of the moon's centre by the Rules in Pages 186, 187.

3. From Page II. of the month in the Nautical Almanac, take out the sun's right ascension, and reduce it to Greenwich mean time (XXII. or XXXIII.)

4. From Pages V. to XII. of the Nautical Almanac, take out the moon's right ascension and declination, for the given day and hour at Greenwich, and reduce them to Greenwich mean time (XLVII.)

5. Take the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich mean time (LI.)

6. Proceed as with the sun, by either of the methods given in Pages 230, 231, to find the moon's meridian distance, and thence compute the apparent and mean time at ship, as directed by the Rules for a Star, in Page 234.

## EXAMPLE I.

August 31, 1835, in latitude 35° 41½′ S. and longitude by account 62° 30′ E. at 1h. 54m. 30s. P. M., apparent time by watch, the observed altitude of the moon's upper limb, east of the meridian, was 34° 33′ 35″, the instrument being adjusted, and the height of the observer's eye 16 feet: required the apparent and mean time at the ship, and thence the error of the watch.

| | h. m. s. |
|---|---|
| App. time at ship, August 31 .... | 1 54 30 |
| | 24 |
| | 25 54 30 |
| Longitude in time E. | 4 10 0 |
| App. time at Greenwich, August 30. | 21 44 30 |
| Equation of time.... | + 20 |
| Mean time at Greenw. | 21 44 50 |

| | ° ′ ″ |
|---|---|
| Obs. alt. ☽'s up. limb | 34 33 35 |
| Dip of horizon.... | — 3 50 |
| | 34 29 45 |
| ☽'s semid. 16′ 7″ / Augment. + 9 | — 16 16 |
| Moon's app. alt... | 34 13 29 |
| Moon's cor. (XXX) | + 47 30 |
| Moon's true alt... | 35 0 59 |

| | h. m. s. |
|---|---|
| Sun's R. A., Aug. 30 .. | 10 32 28 |
| Cor. for 21h. 45m. (XXII) | + 3 18 |
| Sun's R. A. at Greenw. time | 10 35 46 |

In page III. of Aug. in the N.A., the ☽'s semidiameter on the 30th, at 22h. is 16′ 7″, and horizontal parallax 59′ 9″.

| | h. m. s. |
|---|---|
| ☽'s R. A., Aug. 30, at 21h. | 16 40 1 (p. XII. N.A.) |
| Ditto, at 22h. | 16 42 30 |
| Variation in 1 hour .... | 2 29 Log. 1.3831 |
| Greenwich time after 21h. | 44m. 50s. Log. .1266 |
| Variation in 44m. 50s. .. | + 1 51 Log. 1.5097 |
| ☽'s R. A., Aug. 30, at 21h. | 16 40 1 |
| Ditto at Greenwich time . | 16 41 52 |

| | ° ′ ″ |
|---|---|
| ☽'s dec. Aug. 30, at 21h. | 22 54 41 S. (p. XII. N.A.) |
| Ditto, at 22h. | 23 2 26 S. |
| Variation in 1 hour.... | 7 45 Log. .8868 |
| Greenwich time aft. 21h. | 44m. 50s. Log. .1266 |
| Variation in 44m. 50s.. | + 5 47 Log. 1.0154 |
| ☽'s dec. Aug. 30, at 21h. | 22 54 41 S. |
| Ditto at Greenw. time . | 23 0 28 S. |
| | 90 |
| Moon's polar distance . | 66 59 32 |

| | m. s. |
|---|---|
| Eq. of time, Aug. 30, | 0 38 |
| Corr. for 22h. (LI) | — 17 |
| Eq. at Greenw. time | 0 21 |

| | | |
|---|---|---|
| Moon's true altitude . | 35° 1′ | |
| Moon's polar distance | 66 59½ | ..... Co-secant 0.03600 |
| Latitude ..... | 35 41½ | ..... Secant .. 0.09035 |
| Sum ..... | 137 42 | |
| Half-sum ..... | 68 51 | ..... Co-sine.. 9.56728 |
| Remainder ..... | 33 50 | ..... Sine .... 9.74568 |

| | h. m. s. | | |
|---|---|---|---|
| Moon's meridian distance ..... | 4 9 48 | E.... Log..... | 9.42981 |
| Moon's right ascension ..... | 16 41 52 | | |
| Right ascension of meridian ..... | 12 32 4 | | |
| Sun's right ascension ..... | 10 35 46 | | |
| Apparent time at ship ..... | 1 56 18 | ..... | 1 56 18 |
| Equation of time..... | + 21 | Time by watch ..... | 1 54 30 |
| Mean time at ship ..... | 1 56 39 | Watch *slow* for app. time | 1 48 |
| Time by watch ..... | 1 54 30 | | |
| Watch *slow* for mean time ..... | 2 9 | | |

## EXAMPLE II.

October 13, 1835, (civil time,) in latitude 48° 3′ N., when a chronometer which was 2m. 26s. too fast for Greenwich mean time, shewed 10h. 54m. 14s. A. M., the altitude of the moon's upper limb was observed to be 40° 23′ 20″ west of the meridian, the error of the instrument being — 2′ 45″, and the height of the observer's eye 18 feet: required the apparent and mean time at the ship, and the error of the chronometer for the meridian of the place of observation.

| | h. | m. | s. |
|---|---|---|---|
| Mean time by Chronometer, Oct. 12. | 22 | 54 | 14 |
| Chronometer too fast. | — | 2 | 26 |
| Mean time at Greenwich, Oct. 12.... | 22 | 51 | 48 |

| | m. | s. |
|---|---|---|
| Eq. of time, Oct. 12 .. | 13 | 19·9 |
| Cor. for 23h. (L.I.).... | + | 14·2 |
| Eq. at Greenwich time | 13 | 34·1 |

| | ° | ′ | ″ |
|---|---|---|---|
| Obs. alt. ☽'s up. limb | 40 | 23 | 20 |
| Index error ..... | — | 2 | 45 |
| | 40 | 20 | 35 |
| Dip of horizon.... | — | 4 | 4 |
| | 40 | 16 | 31 |
| ☽'s semid. 14′ 50″ Augment. + 10 | — | 15 | 0 |
| Moon's app. alt... | 40 | 1 | 31 |
| Moon's cor. (XXX) | | 40 | 33 |
| Moon's true alt... | 40 | 42 | 4 |

| | h. | m. | s. |
|---|---|---|---|
| Sun's R. A., Oct. 12 .. | 13 | 8 | 2 |
| Cor. for 22h. 52m. (XXII) | + | 3 | 30 |
| Sun's R. A. at Greenw. time | 13 | 11 | 32 |

In page III of Oct. in the N. A., the ☽'s semidiameter, on the 12th. at 23h., is 14′ 50″, and horizontal parallax 54′ 26″.

| | h. | m. | s. | |
|---|---|---|---|---|
| ☽'s R. A., Oct. 12, at 22h. | 6 | 12 | 21 | (p. VII. N.A.) |
| Ditto, at 23h. | 6 | 14 | 34 | |
| Variation in 1 hour .... | | 2 | 13 | Log. 1.4325 |
| Greenw. time after 22 hrs. | 51m. | 48s. | | Log. .0638 |
| Variation in 51m. 48s. .. | + | 1 | 55 | Log. 1.4963 |
| ☽'s R. A., Oct. 12, at 22h. | 6 | 12 | 21 | |
| Ditto at Greenwich time.. | 6 | 14 | 16 | |

| | ° | ′ | ″ | |
|---|---|---|---|---|
| ☽'s dec. Oct. 12, at 22h. | 26 | 15 | 26 | N. (p. VII. N.A.) |
| Ditto, at 23h. | 26 | 17 | 0 | N. |
| Variation in 1 hour .... | | 1 | 34 | Log. 1.8532 |
| Greenw. time after 22h. | 51m. | 48s. | | Log. .0638 |
| Variation in 51m. 48s... | + | 1 | 21 | Log. 1.6409 |
| ☽'s dec. Oct. 12, at 22h. | 26 | 15 | 26 | N. |
| Ditto at Greenwich time. | 26 | 16 | 47 | N. |
| | 90 | | | |
| Moon's polar distance .. | 63 | 43 | 13 | |

| | ° | ′ | | |
|---|---|---|---|---|
| Moon's true altitude .... | 40 | 42 | | |
| Moon's polar distance .. | 63 | 43 | ..... Co-secant | 0. 04739 |
| Latitude ..... | 48 | 3 | ..... Secant .. | 0. 17491 |
| Sum ..... | 152 | 28 | | |
| Half-sum ..... | 76 | 14 | ..... Co-sine.. | 9. 37652 |
| Remainder ..... | 35 | 32 | ..... Sine .... | 9. 76431 |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| Moon's meridian distance ..... | 3 | 49 | 40 | W... Log..... | 9. 86313 |
| Moon's right ascension ..... | 6 | 14 | 16 | | |
| | 10 | 3 | 56 | | |
| | 24 | | | | |
| Right ascension of meridian + 24h. | 34 | 3 | 56 | | |
| Sun's right ascension ..... | 13 | 11 | 32 | | |
| Apparent time at ship ..... | 20 | 52 | 24 | | |
| Equation of time..... | — | 13 | 34 | | |
| Mean time at ship ..... | 20 | 38 | 50 | | |
| Time by chronometer..... | 22 | 54 | 14 | | |
| Chronometer *fast* for mean time .. | 2 | 15 | 24 | | |

| | h. | m. | s. |
|---|---|---|---|
| Apparent time at ship ..... | 20 | 52 | 24 |
| Time by chronometer..... | 22 | 54 | 14 |
| Chron. *fast* for apparent time.... | 2 | 1 | 50 |

*To find the Error of a Watch or Chronometer by equal Altitudes of the Sun.*

RULES.—1. In the morning, when the sun is nearly east, or when it is not less than two or three hours distant from the meridian, take several altitudes of the upper or lower limb, and note the corresponding times that are shewn by the watch or chronometer since the preceding noon. In the afternoon observe when the sun's limb has the same altitude, and note down the times opposite the respective altitudes, reckoning the times of the afternoon altitudes from *noon of the same date* as those taken in the morning.

2. Add together the means of the times at each set of observations; half their sum will be the middle time between the observations, or approximate time by the watch, when the sun is on the meridian; their difference will be the interval of time.

3. Find the equation of equal altitudes, as directed in the Explanation to Table LII., and apply it to the middle time; the result will be the time shewn by the watch at apparent noon, or when the sun is on the meridian at the given place: the difference between that time and 24 hours will be the error of the watch for apparent time.

4. To find the error of the watch for mean time, apply the equation of time (taken from Page I of the Nautical Almanac, and reduced to Greenwich time by Table LI.) to 24 hours, by addition or subtraction, as directed at the head of the column from whence it is taken, and the sum or remainder will be the mean time when it is apparent noon at the place of observation; the difference between which and the time by the watch at apparent noon, will be its error for mean time.

NOTE. This method of finding the error of a watch or chronometer, and thereby regulating its going, is well adapted for practice on shore, where the altitudes may be taken with a sextant by means of an artificial horizon,* and the corresponding times found with great exactness; and it is recommended, in observing, to fix the index of the sextant to some particular division, and wait till the contact of the images take place.

## EXAMPLE I.

July 22, 1835, (civil time), at Edinburgh, in latitude 55° 58′ N., and *long*itude 3° 10′ W., the following observations were made at equal altitudes of the sun's lower limb: required the error of the watch for apparent and mean time at Edinburgh.

| Alts. Sun's L. L. | Times A.M. | Times P.M. |
|---|---|---|
| ° ′ | h. m. s. | h. m. s. |
| 35 10 | 20 8 20 | 27 43 42 |
| 35 20 | 9 29 | 42 35 |
| 35 30 | 10 37 | 41 24 |
| | 3) 28 26 | 127 41 |
| Means | 20 9 29 | 27 42 34 |
| | 27 42 34 | 20 9 29 |
| Interval | 7 33 5 | 2) 47 52 3 |
| | Middle time... | 23 56 1 |

| | ° ′ ″ |
|---|---|
| Sun's decl. July 21, (P.II. N.A.) | 20 35 36 N. |
| Ditto, July 23 | 20 12 4 N. |
| Change in two days | 23 32 |
| | = 1412″ |
| Sun's decl. July 22, (P.II. N.A.) | 20° 24′ N. |
| | 90 |
| Sun's polar distance | 69 36 |

* For a description of the several kinds of artificial horizons, and the method of taking altitudes with them, see page 223.

| | | | | | |
|---|---|---|---|---|---|
| Interval..... 7h. 33m. | Log. A. 7.7978 | ..... Log. B. 7.5383 |
| Ch. in 2 days 1412″ | Log. ... 3.1498 | ..... 3.1498 |
| Latitude..... 55° 58′ | Tang. 0.1705 | Polar Dist. 69° 36′ Co-tan. 9.5704 |
| First part + 13ˢ.13 | Log. ... 1.1181 | Second part − 1ˢ.81 Log. 0.2585 |
| Second part − 1 .81 | | |
| + 11 .32 Equation of equal altitudes. | | |

| | h. | m. | s. | | | m. | s. |
|---|---|---|---|---|---|---|---|
| Time at Edinburgh, July 22..... | 0 | 0 | 0 | Equation of time, July 22... + | 6 | 3.4 |
| Longitude in time ..... | | 12 | 40 W. | Corr. for Greenwich time (LI.) | | 0.0 |
| Time at Greenwich..... | 0 | 12 | 40 | Equation at Greenwich time + | 6 | 3.4 |

| | h. | m. | s. | | h. | m. | s. |
|---|---|---|---|---|---|---|---|
| Middle time by watch..... | 23 | 56 | 1 | | | | |
| Equation of equal altitudes..... | + | | 11 | | | | |
| Time by watch at apparent noon ... | 23 | 56 | 12 | ..... | 23 | 56 | 12 |
| | 24 | | | | | | |
| Watch *slow* for apparent time ..... | | 3 | 48 | | | | |

Mean time at apparent noon = 24h. + Equation of time 6m. 3s. = 24 6 3

Watch *slow* for mean time at Edinburgh ..... 9 51

## EXAMPLE II.

April 10, 1835, (civil time), at Bombay, in latitude 18° 56′ N., and longitude 72° 54′ E., the following equal altitudes of the sun's lower limb were observed, with the corresponding times by a chronometer: required the error of the chronometer for apparent and mean time at Bombay.

| Alts. Sun's L. L. | Times by Chro. A.M. | Times by Chro. P.M. | | |
|---|---|---|---|---|
| ° ′ | h. m. s. | h. m. s. | | ° ′ ″ |
| 29 0..... | 15 1 54..... | 23 18 12 | Sun's decl. April 9, (P.II.N.A.) | 7 24 53 N. |
| 29 5..... | 2 16..... | 17 49 | Ditto, April 11 ..... | 8 9 19 N. |
| 29 15..... | 3 3..... | 17 1 | | |
| 29 20..... | 3 24..... | 16 41 | Change in two days..... | 44 26 |
| | | | = 2666″ | |
| | 4) 10 37 | 69 43 | | ° ′ |
| Means ..... | 15 2 39 | 23 17 26 | Sun's decl. April 10, (P.II.N.A.) | 7 47 N. |
| | 23 17 26 | 15 2 39 | | 90 |
| Interval..... | 8 14 47 | 2)38 20 5 | Sun's polar distance..... | 82 13 |
| | Middle time... | 19 10 2 | | |

| | | | |
|---|---|---|---|
| Interval..... 8h. 15m. | Log. A. 7.8126 | ..... Log. B. 7.4860 |
| Ch. in 2 days 2666″ | Log. ... 3.4259 | ..... 3.4259 |
| Latitude..... 18° 56′ | Tang.... 9.5353 | Polar Dist. 82° 13′ Co-tan. 9.1357 |
| First part... − 5ˢ.94 | Log. ... 0.7738 | Second part + 1ˢ.12 Log. 0.0476 |
| Second part + 1 .12 | | |
| − 4 .82 Equation of equal altitudes. | | |

| | h. | m. | s. | | m. | s. |
|---|---|---|---|---|---|---|
| Time at Bombay, April 9 ..... | 24 | 0 | 0 | Equation of time, April 9... + | 1 | 44.8 |
| Longitude in time ..... | 4 | 51 | 36 E. | Corr. for 19h. 8m. (LI)..... − | | 13.5 |
| Time at Greenwich..... | 19 | 8 | 24 | Equation at Greenwich time + | 1 | 31.3 |

| | h. | m. | s. | | h. | m. | s. |
|---|---|---|---|---|---|---|---|
| Middle time by chronometer ..... | 19 | 10 | 2 | | | | |
| Equation of equal altitudes ..... | | − | 5 | | | | |
| Time by chronometer at app. noon . | 19 | 9 | 57 | ..... | 19 | 9 | 57 |
| | 24 | | | | | | |
| Chron. *slow* for app. time at Bombay | 4 | 50 | 3 | | | | |

Mean time at apparent noon = 24h. + Equation of time 1m. 31s. = 24 1 31

Chronometer *slow* for mean time at Bombay..... 4 51 34

### EXAMPLE FOR EXERCISE.

February 23, 1835, (civil time), at Funchal, in latitude 32° 37′ 42″ N., and longitude 16° 55′ 30″ W., the mean of several times taken in the morning, shewn by a chronometer, was 9h. 24m. 8s., and the mean of the times corresponding to the same altitudes of the sun's lower limb, taken in the afternoon, was 5h. 13m. 40s.: required the error of the chronometer for apparent and mean time, at the meridian of Funchal.

Answer. The chronometer is 1h. 18m. 42s. fast for apparent time, and 1h. 5m. 0s. fast for mean time, at Funchal.

## ON FINDING THE LONGITUDE BY CHRONOMETERS.

It has already been observed, that if a chronometer could be made to shew always precisely the mean time at Greenwich, or any other given meridian, the longitude of a place, from that meridian, might be easily computed, by comparing the time shewn by the chronometer with that at the given place; but it is hardly to be expected that such a complicated machine can perform so accurately, as never to deviate from the time at the meridian to which it is set: nor indeed is this absolutely necessary; for if its error at the given meridian be known on a certain day, and also its rate (which is its daily gain or loss in 24 hours of mean time), we can thence deduce the time at that meridian as well as if the hands of the chronometer actually pointed out, provided that it go uniformly, which is all that is essential in the notion of a chronometer. In order, therefore, to obtain these particulars, it is usual for the maker, or person to whose care the machine is entrusted, to examine its error every day, by comparing it with a well-regulated astronomical clock; these errors being then set down in a book kept by him for the purpose, the daily differences shew its rate, and the regularity of its motion.

If the errors or daily differences continue the same, the chronometer is said to have no rate, and is keeping mean time exactly. Should the chronometer be too fast, and the error increasing, it is gaining on mean time; but if the error be decreasing, it is then losing: on the contrary, when the chronometer is too slow, and the error increasing, it is losing on mean time; but if the error be decreasing, it is gaining. The rate and error of a chronometer may likewise be ascertained by altitudes of the sun, as will be shewn hereafter. For instance, suppose on a certain day a chronometer was found, by altitudes of the sun, to be 5h. 30m. 10s. too fast for mean time, at the meridian of Madras; and that by observations, taken ten days afterwards, it was 5h. 30m. 40s. too fast, at the same meridian; I thence find that it has gained 30 seconds in 10 days, and conclude that its daily gain is 3 seconds. Again, suppose on August 13th, a chronometer was 12m. 10s. too fast for mean time at Greenwich; but by observations, taken on August 28th, it was found to be 10m. 40s. too fast for mean time at the same place; here it appears that the chronometer has lost 1m. 30s. or 90 seconds in 15 days, and consequently is losing 6 seconds daily. Observations of this kind should be repeated and compared together as often as convenient, in order to find the rate the chronometer has gone at between every two such observations, by which the regularity of its going will be proved. Having by these means established its rate and error at the meridian of the place of observation, the longitude of a ship on her voyage may be found by the following

RULES.—1. Take several altitudes of the sun, or other celestial object, when it bears as nearly east or west as possible, but always at least three hours distant from the meridian, and note the times by a chronometer when they are observed, of which take the means.

2. To the mean of the times apply the *original error*, that is, add what the chronometer was too slow, or subtract what it was too fast, for mean time on a given day, at the meridian of the place where the rate was ascertained: the sum or remainder will be the mean time by chronometer, corrected for the original error.

3. Multiply the *daily rate* by the number of days and parts of a day that have elapsed since the original error was determined; the product, which may be called the *accumulated rate*, being added to the above sum or remainder, if the chronometer be losing, or subtracted from it if gaining, the result will give the mean time at the meridian where the rate and original error were ascertained. Should the meridian not be that of Greenwich, then add the longitude of the place in time, if it be west, or subtract it, if east; and the sum or remainder will be the corresponding mean time at Greenwich by chronometer.

4. With the latitude of the place of observation, the true altitude of the sun or other celestial object, and the reduced declination, find the mean time at the place of observation, as directed by the Rules in Pages 230, 233, 236, or 238; the difference between which, and the mean time at Greenwich, obtained by the chronometer, will give the longitude; east, if the time at the ship be greater, or west, if it be less, than the time at Greenwich.

## EXAMPLE I.

May 19, 1835, P. M., in latitude 42° 15′ N., the following altitudes of the sun's lower limb were observed, with the corresponding times by a chronometer (being P. M. at Greenwich), whose daily gain had been settled at noon, March 17, at 7.8s., when it was 1m. 18s. too fast for mean time at Greenwich; the instrument having no index error, and the height of the observer's eye being 26 feet above the sea: required the true longitude of the ship.

| Times by Chro. | Alts. ⊙'s L.L. |
|---|---|
| h. m. s. | ° ′ |
| 6 58 40 | 44 7 |
| 6 59 36 | 43 57 |
| 7 0 51 | 43 44 |
| 7 2 12 | 43 33 |
| 7 3 21 | 43 24 |
| 5)35 4 40 | 218 45 |
| 7 0 56 | 43 45 |
| − 1 18 | Original err. |
| 6 59 38 | |
| − 8 14 | Accumulated rate. |
| 6 51 24 | Mean time at Greenwich, May 19. |

| | ° ′ ″ |
|---|---|
| Obs. alt. sun's L. L.... | 43 45 0 |
| Dip of horizon ..... | − 4 52 |
| | 43 40 8 |
| Sun's corr. (XVIII) ... | − 53 |
| | 43 39 15 |
| Sun's semidiameter ... | + 15 49 |
| Sun's true altitude ... | 43 55 4 |

| | s. |
|---|---|
| Daily gain ..... | 7.8 |
| Days from March 17 to May 19 ..... | 63 |
| | 234 |
| | 468 |
| 60) | 491.4 |
| Gain in 63 days | 8m. 11.4s. |
| Ditto in 7 hours | + 2.3 |
| Accumulated rate | 8m. 13.7s. |

| | m. | s. |
|---|---|---|
| Equation of time, May 19.. | 3 | 51.8 |
| Corr. for 6h. 51m. (LI.) ... | − | 0.9 |
| Eq. at Greenwich time..... | 3 | 50.9 |

| | ° ′ ″ |
|---|---|
| Sun's declin. May 19 (P. II, N. A.)... | 19 40 29 N. |
| Correction for 6h. 51m. (XXI.)..... | + 3 44 * |
| Sun's declination at Greenwich time | 19 44 13 N. |
| | 90 |
| Sun's polar distance..... | 70 15 47 |

| | ° ′ | | |
|---|---|---|---|
| Sun's true altitude..... | 43 55 | | |
| Polar distance..... | 70 16 | .....Co-secant | 0.02628 |
| Latitude ..... | 42 15 | .....Secant ... | 0.13064 |
| Sum..... | 156 26 | | |
| Half-sum..... | 78 13 | .....Co-sine... | 9.31008 |
| Remainder ..... | 34 18 | .....Sine ..... | 9.75091 |
| | h. m. s. | | |
| Apparent time at ship... | 3 11 50 | .....Log. ..... | 9.21791 |
| Equation of time ..... | − 3 51 | | |
| Mean time at ship ..... | 3 7 59 | May 19. | |
| Mean time at Greenwich | 6 51 24 | May 19. | |
| Longitude in time ..... | 3 43 25 = 55° 51′ 15″ West. | | |

* Or the *diff. for* 1 *hour*, 32″.15, taken from Page I. of the N. A., being multiplied by 7 (the hours of mean time nearly, at Greenwich) will give 225″.05 = 3′ 45″ for the correction of the declination.

## EXAMPLE II.

April 22, 1835, a chronometer was 2h. 31m. 45s. too fast for mean time at Greenwich, and was gaining 2.1s. per day.

June 24, 1835, (June 25, A. M. civil time), in latitude 10° 8′ 30″ S., the following altitudes of the sun's lower limb were observed, with the corresponding times by the same chronometer (being A. M. at Greenwich), the height of the observer's eye above the sea being 20 feet, and the error of the sextant 1′ 30″ to add: required the true longitude of the ship.

| Times by Chro. | Alts. ⊙'s L.L. |
|---|---|
| h. m. s. | ° ′ |
| 23 28 35 | 10 7 |
| 29 20 | 10 17 |
| 30 48 | 10 32 |
| 32 6 | 10 54 |
| 33 24 | 11 14 |
| 5) 154 13 | 53 4 |
| 23 30 51 | 10 36 48 |
| 2 31 45 | Original error. |
| 20 59 6 | |
| — 2 14 | Accum. rate. |
| 20 56 52 | Mean time at Greenwich, June 24. |

| | ° ′ ″ |
|---|---|
| Obs. alt. sun's L. L.... | 10 36 48 |
| Index error ..... | + 1 30 |
| | 10 38 18 |
| Dip of horizon ..... | — 4 17 |
| | 10 34 1 |
| Sun's corr. (XVIII.). | — 4 50 |
| | 10 29 11 |
| Sun's semidiameter ... | + 15 45 |
| Sun's true altitude ... | 10 44 56 |

| | s. |
|---|---|
| Daily gain ..... | 2.1 |
| Days from April 22 to June 24 ..... | 63 |
| | 63 |
| | 126 |
| 60) | 132.3 |
| Gain in 63 days ... | 2 12.3 |
| Do. in 20h. 59m. = | + 1.8 |
| Accumulated rate... | 2 14.1 |

| | m. s. |
|---|---|
| Equation of time, June 24... | 1 52.0 |
| Corr. for 20h. 57m. (LI.) ... | + 11.4 |
| Equation at Greenwich time.. | 2 3.4 |

| | ° ′ ″ |
|---|---|
| Sun's declin. June 24, (P. II. N. A.) ... | 23 26 36 N. |
| Diff. for 1h., 2″.88 × 21h. = 60″.48 = | — 1 0 |
| Sun's declination at Greenwich time ... | 23 25 36 N. |
| | 90 |
| Sun's polar distance..... | 113 25 36 |

| | ° ′ | | |
|---|---|---|---|
| Sun's true altitude..... | 10 45 | | |
| Polar distance..... | 113 25½ | Co-secant | 0.03736 |
| Latitude ..... | 10 3½ | Secant ... | 0.00678 |
| Sum ..... | 134 14 | | |
| Half-sum ..... | 67 7 | Co-sine.. | 9.58979 |
| Remainder ..... | 56 22 | Sine..... | 9.92044 |
| | h. m. s. | | |
| Time from noon..... | 4 54 11 | Log..... | 9.55432 |
| | 24 | | |
| Apparent time at ship... | 19 5 49 | | |
| Equation of time..... | + 2 3 | | |
| Mean time at ship ..... | 19 7 52 | June 24. | |
| Mean time at Greenw.. | 20 56 52 | June 24. | |
| Longitude in time ..... | 1 49 0 | = 27° 15′ West. | |

## EXAMPLE III.

October 18, 1835, P. M., in latitude 15° 46′ N., the observed altitude of the sun's lower limb was 12° 40′, when a chronometer shewed 11h. 12m. 42s. (being A. M. at Greenwich), whose error, on August 12, was 5m. 26s. too slow at noon for Greenwich mean time, and was gaining 12. 5s. per day; the index error of the instrument being + 2′ 30″, and height of the observer's eye 16 feet: required the true longitude of the ship.

| | h. m. s. |
|---|---|
| Time by chron. Oct. 17 | 23 12 42 |
| Original error | + 5 26 |
| | 23 18 8 |
| Accumulated rate | − 13 57 |
| Mean time at Green. Oct. 17 | 23 4 11 |

| | ° ′ ″ |
|---|---|
| Obs. alt. sun's L. L. | 12 40 0 |
| Index error | + 2 30 |
| | 12 42 30 |
| Dip of horizon | − 3 50 |
| | 12 38 40 |
| Sun's corr. (XVIII) | − 4 2 |
| | 12 34 38 |
| Sun's semidiam. | + 16 5 |
| Sun's true altitude | 12 50 43 |

| | s. |
|---|---|
| Daily gain | 12.5 |
| Days from Aug. 12 to Oct. 17 | 66 |
| | 750 |
| | 750 |
| | 60) 825.0 |
| Gain in 66 days | 13m. 45. 0s. |
| Ditto in 23h. 18m. | + 12.2 |
| Accumulated rate | 13 57.2 |

| | m. s. |
|---|---|
| Equation of time, Oct. 17, | 14 27.6 |
| Correction for 23h. (LI.) | + 11.5 |
| Equation at Greenw. time, | 14 39.1 |

| | ° ′ ″ |
|---|---|
| Sun's declination, Oct. 17, (P. II. N. A.) | 9 5 56 S. |
| Correction for 23h. 4m. (XXI). | + 21 5* |
| Sun's declination at Greenwich time | 9 27 1 S. |
| | 90 |
| Sun's polar distance | 99 27 1 |

| | ° ′ | | |
|---|---|---|---|
| Sun's true altitude | 12 51 | | |
| Polar distance | 99 27 | Co-secant | 0.00593 |
| Latitude | 15 46 | Secant | 0.01666 |
| Sum | 128 4 | | |
| Half-sum | 64 2 | Co-sine | 9.64132 |
| Remainder | 51 11 | Sine | 9.89162 |
| | h. m. s. | | |
| Apparent time at ship | 4 54 39 | Log. | 9.55553 |
| Equation of time | − 14 39 | | |
| Mean time at ship | 4 40 0 | October 18. | |
| | 24 | | |
| Ditto | 28 40 0 | October 17. | |
| Mean time at Greenw. | 23 4 11 | October 17. | |
| Longitude in time | 5 35 49 = 83° 57′ 15″ East. | | |

* Or the diff. for 1 hour 55″.00 × 23h. = 1265″.00 = 21 5′.

## EXAMPLE IV.

April 25, 1835, A. M. (civil time), in latitude 27° 20′ S., the observed altitude of the sun's upper limb was 18° 42′ 50″, when a timekeeper shewed 2h. 12m. 50s. (being P. M. at Greenwich), which at noon, April 2, was 1h. 10m. 15s. too fast for mean time at Greenwich, and was losing 4. 3s. per day; the error of the sextant being + 2′ 40″, and the height of the observer's eye 30 feet: required the true longitude of the ship.

| | h. | m. | s. |
|---|---|---|---|
| Time by chron..... | 2 | 12 | 50 |
| Original error ..... | 1 | 10 | 15 |
| | 1 | 2 | 35 |
| Accumulated rate. | + | 1 | 39 |
| Mean time at Greenw. Apr. 25 | 1 | 4 | 14 |
| | 24 | | |
| Ditto, past noon, April 24..... | 25 | 4 | 14 |

| | ° | ′ | ″ |
|---|---|---|---|
| Obs. alt. sun's U.L. | 18 | 42 | 50 |
| Index error..... | + | 2 | 40 |
| | 18 | 45 | 30 |
| Dip of horizon ... | − | 5 | 15 |
| | 18 | 40 | 15 |
| Sun's corr.(XVIII) | − | 2 | 39 |
| | 18 | 37 | 36 |
| Sun's semidiameter | − | 15 | 55 |
| Sun's true altitude | 18 | 21 | 41 |

| | s. |
|---|---|
| Daily loss ..... | 4.3 |
| Days from April 2 to April 25 ..... | 23 |
| | 129 |
| | 86 |
| | 60) 98.9 |
| Loss in 23 days ... | 1m.38.9s. |
| Ditto in 1h.3m. ... | + .2 |
| Accumulated rate . | 1m.39.1s. |

| | m. | s. |
|---|---|---|
| Equation of time, April 25, | 2 | 3.6 |
| Corr. for 1h.4m. (LI)..... | + | 0.4 |
| Equation at Greenw. time, | 2 | 4.0 |

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Sun's declination, April 25, (P. II. N. A.) | 13 | 2 | 43 | N. |
| Correction for 1h. 4m. (XXI)..... | + | 0 | 53* | |
| Sun's declination at Greenwich time..... | 13 | 3 | 36 | N. |
| | 90 | | | |
| Sun's polar distance..... | 103 | 3 | 36 | |

| | ° | ′ | ″ | | |
|---|---|---|---|---|---|
| Sun's true altitude..... | 18 | 21 | 41 | | |
| Polar distance..... | 103 | 3 | 36 | .....Co-secant | 0.011381 |
| Latitude ..... | 27 | 20 | 0 | .....Secant ... | 0.051416 |
| Sum..... | 148 | 45 | 17 | | |
| Half-sum..... | 74 | 22 | 38 | .....Co-sine... | 9.430241 |
| Remainder ..... | 56 | 0 | 57 | .....Sine ..... | 9.918655 |
| | h. | m. | s. | | |
| Time from noon..... | 4 | 4 | 14 | .....Log. ..... | 9.41169. |
| | 24 | | | | |
| Apparent time at ship | 19 | 55 | 46 | | |
| Equation of time..... | − | 2 | 4 | | |
| Mean time at ship..... | 19 | 53 | 42 | April 24. | |
| Mean time at Greenw. | 25 | 4 | 14 | April 24. | |
| Longitude in time..... | 5 | 10 | 32 | = 77° 38′ West. | |

* Or the diff. for 1 hour, 48″. 85, may be taken for the correction.

## EXAMPLE V.

January 27, 1835, P. M., in latitude 6° 58′ N., the following altitudes of the sun's lower limb were observed, corresponding to the times shewn by a chronometer (originally set to Greenwich mean time, where it was A. M. at the time of observation), whose error and rate were settled at Bombay, in longitude 72° 54′ 24″ E. on January 16th, having on that day, at noon, been 5h. 17m. 42s. too slow, and losing 5. 4s. daily; the height of the observer's eye being 18 feet, and the instrument having no index error: required the true longitude of the ship.

| Times by Chron. | | | Alt. Sun's L. L. | |
|---|---|---|---|---|
| h. | m. | s. | ° | ′ |
| 23 | 4 | 26 | 18 | 42 |
| | 7 | 17 | 18 | 12 |
| | 9 | 30 | 17 | 41 |
| 3) | 21 | 13 | 54 | 35 |
| 23 | 7 | 4 | 18 | 11 40 |
| 5 | 17 | 42 | Original error. | |
| 28 | 24 | 46 | | |
| + | 1 | 0 | Accumulated rate. | |
| 28 | 25 | 46 | Mean time at Bombay, past noon, Jan. 26. | |
| 4 | 51 | 38 | Longitude of Bombay, (in time) E. | |
| 23 | 34 | 8 | Mean time at Greenwich, Jan. 26. | |

| | ° | ′ | ″ |
|---|---|---|---|
| Obs. alt. sun's L. L. | 18 | 11 | 40 |
| Dip of horizon ... | − | 4 | 4 |
| | 18 | 7 | 36 |
| Sun's corr.(XVIII) | − | 2 | 45 |
| | 18 | 4 | 51 |
| Sun's semidiam.... | + | 16 | 16 |
| Sun's true altitude | 18 | 21 | 7 |
| | 90 | | |
| Sun's zenith dist. . | 71 | 38 | 53 |

| | s. |
|---|---|
| Daily loss ..... | 5. 4 |
| Days from Jan. 16 to Jan. 27 ..... | 11 |
| Loss in 10 days..... | 59. 4 |
| Ditto in 4h. 25m.... | + 0. 9 |
| | 60) 60. 3 |
| Accumulated rate . | 1m. 0. 3s. |

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Sun's declination, Jan. 26, | 18 | 49 | 7 | S. (P. II., N. A.) |
| Ditto, Jan. 27, | 18 | 33 | 55 | S. |

| | m. | s. |
|---|---|---|
| Eq. of time, Jan. 26, | 12 | 48.3 |
| Cor. for 23h. 34m. (LI). | + | 12.8 |
| Eq. of Greenw. time | 13 | 1.1 |

| | | | | |
|---|---|---|---|---|
| Variation in 24 hrs..... | 15 | 12 | Log. | 1984 (XXXIII). |
| Greenwich time ..... | 23h. | 34m. | Log. | 0079 |
| Variation in 23h. 34m. ... | − 14 | 55 | Log. | 2063 |
| Sun's declination, Jan. 26, | 18 | 49 | 7 S. | |
| Ditto at Greenwich time . | 18 | 34 | 12 S. | |

| | ° | ′ | ″ | | | |
|---|---|---|---|---|---|---|
| Latitude ..... | 6 | 58 | 0 N. | ..... | Secant | 0.003218 |
| Sun's declination..... | 18 | 34 | 12 S. | ..... | Secant | 0.023213 |
| | | | | | | 9 |
| Sum ..... | 25 | 32 | 12 | | | |
| Zenith distance ..... | 71 | 38 | 53 | | | |
| | | | | | | 60 |
| Sum ..... ..... | 97 | 11 | 5 | Half 48 35 32... | Sine ... | 9.875014 |
| Difference..... | 46 | 6 | 41 | Half 23 3 20... | Sine ... | 9.592770 |
| | | | | | | 99 |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| App. time at ship..... | 4 | 31 | 44 | ..... | Log.... 9.49438. |
| Equation of time ..... | + | 13 | 1 | | |
| Mean time at ship ..... | 4 | 44 | 45 | Jan. 27. | |
| | 24 | | | | |
| Ditto ..... | 28 | 44 | 45 | Jan. 26. | |
| Mean time at Greenwich... | 23 | 34 | 8 | Jan. 26. | |
| Longitude in time ..... | 5 | 10 | 37 | = 77° 39′ 15″ E. | |

## EXAMPLE VI.

**May 28, 1835, P. M., in latitude 0° 47½′ N., the mean of several altitudes of the Star Antares, when eastward of the meridian, was 30° 42′ 30″, the height of the observer's eye being 16 feet, and the mean of the corresponding times by a chronometer 10h. 13m. 21s. P. M., which had been found, May 5, at James Town, St. Helena, in longitude 5° 45′ 20″ W., 0h. 54m. 32s. too fast for mean time at noon, and gaining daily 15. 4s.: required the true longitude of the ship.**

| | h. m. s. |
|---|---|
| Time by chron.. | 10 13 21 |
| Original error... | − 54 32 |
| | 9 18 49 |
| Accum. rate ... | − 6 0 |
| Mean time at St. Helena... | 9 12 49 |
| Long. of Ditto in time ..... | + 23 1 W. |
| Mean time at Greenwich... | 9 35 50 |

| | ° ′ ″ |
|---|---|
| Star's observed alt. | 30 42 30 |
| Dip of horizon ... | − 3 50 |
| | 30 38 40 |
| Refraction ..... | − 1 37 |
| Star's true altitude | 30 37 3 |

| | h. m. s. |
|---|---|
| Sun's R. A., May 28, | 4 18 5 |
| Corr. for 9h. 36m.... | + 1 37 |
| ⊙'s R.A. at Gr. time | 4 19 42 |

| | s. |
|---|---|
| Daily gain..... | 15.4 |
| Days from May 5 to May 28 ..... | 23 |
| | 60) 354.2 |
| Gain in 23 days ... | 5m. 54. 2s. |
| Gain in 9h. 19m.... | + 5.9 |
| Accumulated rate. | 6m. 0. 1s. |

| | h. m. s. | ° ′ ″ |
|---|---|---|
| Star's Rt. Ascen., Jan. 1834 (XIII) | 16 19 14 | Star's dec., Jan. 1834 (XIII). 26 3 18 S. |
| Annual variation + 3s. 66 × 1¼ = | + 0 5 | Ann. variation + 8″. 53 × 1¼ = + 0 13 |
| Star's right ascension, May 1835... | 16 19 19 | Star's declination, May 1835, 26 3 31 S. |
| | | 90 |
| | | Star's polar distance .....116 3 31 |

| | ° ′ | | |
|---|---|---|---|
| Star's true altitude..... | 30 37 | | |
| Star's polar distance .....116 | 3½ | ..... | Co-secant 0.04656 |
| Latitude ..... | 0 47½ N. | ..... | Secant ... 0.00004 |
| Sum..... | 147 28 | | |
| Half-sum..... | 73 44 | ..... | Co-sine . 9.44733 |
| Remainder ..... | 43 7 | ..... | Sine ..... 9.83473 |
| | h. m. s. | | |
| Star's meridian distance... | 3 39 58 E. | ..... | Log..... 9.32866 |
| Star's right ascension ... | 16 19 19 | | |

| | h. m. s. | | m. s. |
|---|---|---|---|
| Right ascen. of meridian. | 12 39 21 | Eq. of time, May 28, | 3 9.3 |
| Sun's right ascension ... | 4 19 42 | Corr. for 9h. 36m. ... | − 2.8 |
| Apparent time at ship ... | 8 19 39 | Eq. at Greenw. time. | 3 6.5 |
| Equation of time ..... | − 3 7 | | |
| Mean time at ship..... | 8 16 32 | May 28. | |
| Mean time at Greenwich | 9 35 50 | May 28. | |
| Longitude in time..... | 1 19 18 | = 19° 49′ 30″ West. | |

NOTE. The mean time at the ship or place of observation may be computed by an altitude of a planet or the moon, by the rules in pages 236, 238, which, being compared with the mean time at Greenwich, deduced from a chronometer, will give the longitude as in the preceding Examples.

In the last two Examples the errors of the chronometers are given for the places where the rates were ascertained; but as it may be more convenient to have their errors on mean time at Greenwich, these may be obtained by applying the longitude in time to the mean time at the place of observation (subtracting in east longitude, and adding in west): the result will shew the mean time at Greenwich.

Suppose (Example V.) that by an observation taken at Bombay, January 16, 1835, the chronometer shewed at mean noon 18h. 42m. 18s.: required its error on Greenwich mean time.

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean time at Bombay (mean noon) | 24 | 0 | 0 | January 15. |
| Longitude of Bombay in time | 4 | 51 | 38 | E. |
| Corresponding mean time at Greenwich | 19 | 8 | 22 | |
| Mean time shewn by the chronometer | 18 | 42 | 18 | |
| Chronometer *slow* for Greenwich mean time | 0 | 26 | 4 | |

Then to find the mean time at Greenwich when the altitudes were taken on January 27th, we should proceed thus:

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean of times by chronometer | 23 | 7 | 4 | January 26. |
| Original error for Greenwich mean time (January 16) | + | 26 | 4 | |
| | 23 | 33 | 8 | |
| Accumulated rate | + | 1 | 0 | |
| Mean time at Greenwich when altitudes were taken | 23 | 34 | 8 | |

In Example VI. suppose May 5, 1835, at St. Helena, the chronometer shewed 0h. 54m. 32s., when it was mean noon at that place: required its error on Greenwich mean time.

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean time at St. Helena (mean noon) | 0 | 0 | 0 | May 5. |
| Longitude of St. Helena | 0 | 23 | 1 | W. |
| Corresponding mean time at Greenwich | 0 | 23 | 1 | |
| Mean time shewn by the chronometer | 0 | 54 | 32 | |
| Chronometer *fast* for Greenwich mean time | 0 | 31 | 31 | |

Then to find Greenwich mean time when the observations were made, May 28th.

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean time by chronometer | 10 | 13 | 21 | May 28. |
| Original error for Greenwich mean time (May 5) | − | 31 | 31 | |
| | 9 | 41 | 50 | |
| Accumulated rate | − | 6 | 0 | |
| Mean time at Greenwich when altitudes were taken | 9 | 35 | 50 | |

When several chronometers are on board, the time shewn by one of them, with a corresponding set of altitudes, will serve to find the longitude

by them all; for this purpose the observer is to compare one of the chronometers with each of the others, immediately before the observations, and note their differences; these differences are to be applied to the mean of the times shewn by the above chronometer, when the altitudes are taken, which will give the corresponding times by each chronometer. To these apply their original errors and accumulated rates, and the result will be the several mean times at Greenwich, or other meridian to which the chronometers are set; the differences between which and the mean time at ship, deduced from the altitudes, will give the longitude according to each chronometer.

It is the practice with many persons to use a good pocket-watch, having a hand that points out seconds, instead of noting the times by one of the chronometers. When this plan is adopted, the comparisons are to be made before the observations, as above directed, and the differences applied to the times shewn by the watch when the altitudes are taken.

To ensure accuracy, it may be advisable to compare the watch with the chronometers immediately after the observations are made; and if the differences be not the same, a proportional part of the change of differences should be applied to those shewn before the observation.

## EXAMPLE VII.

November 15, 1834, a chronometer, No. 156, was 5m. 13s. slow for mean time at Greenwich, and losing daily 6. 4s.

January 24, 1835, (January 25th A. M. civil time), in latitude 26° 53′ S., the following altitudes were observed, with the corresponding times by the above chronometer, which had been previously compared with Nos. 284, 376, and 807: required the longitude by each chronometer; also the longitude brought up to noon; the ship having made 10 miles of longitude west between the time of observation and noon; the height of the eye being 20 feet, and the index error of the sextant 1′ to add.

| Times by chron. No. 156. | | Alts. | Sun's L. L. |
|---|---|---|---|
| h. m. s. | | ° ′ ″ | |
| 16 37 16 | | 24 23 15 | |
| 38 1 | | 32 50 | |
| 38 47 | | 39 30 | |
| 3) 114 4 | | 95 35 | |
| Means | 16 38 1 | 24 31 52 | |
| Original error | + 5 13 | Index error | + 1 0 |
| | 16 43 14 | 24 32 52 | |
| Accum. rate | + 7 33 | Dip of horizon | − 4 17 |
| Mean time at Greenwich | 16 50 47 | ⊙'s corr. (XVIII.) | 24 28 35 − 1 57 |
| | | | 24 26 38 |
| | | Sun's semidiameter | + 16 16 |
| | | ⊙'s true altitude | 24 42 54 |

| | s. |
|---|---|
| Daily loss of chron. No. 156, | 6.4 |
| Days elapsed since Nov. 15, | 70 |
| | 60) 448.0 |
| Loss in 70 days | 7m. 28.0s. |
| Ditto in 16h. 43m. | + 4.6 |
| Accumulated rate | 7m. 32.6s. |

| | ° ′ ″ |
|---|---|
| Sun's declin., Jan. 24, | 19 18 29 S. |
| Diff. in 1h., 36″.29 × 17h. = 616″.93 = | − 10 17 |
| Sun's declination at Greenwich time | 19 8 12 S. |
| | 90 |
| Sun's polar distance | 70 51 48 |

| | ° | | | |
|---|---|---|---|---|
| True altitude | 24 | 43 | | |
| Polar distance | 70 | 52 | .....Co-secant ... | 0.02468 |
| Latitude | 26 | 53 | .....Secant ..... | 0.04967 |
| Sum | 122 | 28 | | |
| Half-sum | 61 | 14 | .....Co-sine ..... | 9.68237 |
| Remainder | 36 | 31 | .....Sine ..... | 9.77456 |
| | h. | m. | s. | |
| Time from noon | 4 | 45 | 16 | .....Log ..... 9.53128 |
| | 24 | | | |

| | | | | | m. | s. |
|---|---|---|---|---|---|---|
| Apparent time at ship..... | 19 | 14 | 44 | Equation of time, Jan. 24... | 12 | 20.4 |
| Equation of time ..... | + 12 | 30 | | Correc. for 16h. 51m. (LI.) | + | 9.8 |
| Mean time at ship ..... | 19 | 27 | 14 | Equation at Greenwich time | 12 | 30.2 |
| Mean time at Greenwich by chronometer, No. 156 ... | 16 | 50 | 47 | | | |

| | | | | | ° | ′ | ″ | |
|---|---|---|---|---|---|---|---|---|
| Longitude in time by ditto... | 2 | 36 | 27 | = | 39 | 6 | 45 | East. |
| Longitude made to noon..... | | | | — | 10 | 0 | | West. |
| Longitude at noon ..... | | | | | 38 | 56 | 45 | East. |

| | No. 284. | | | No. 376. | | | No. 807. | | |
|---|---|---|---|---|---|---|---|---|---|
| | h. | m. | s. | h. | m. | s. | h. | m. | s. |
| Chronometer, No. 156..... | 16 | 12 | 41 | 16 | 13 | 26 | 16 | 14 | 35 |
| Chronometers ..... | 16 | 16 | 18 | 16 | 23 | 42 | 16 | 8 | 53 |
| Differences..... | + | 3 | 37 | + | 10 | 16 | — | 5 | 42 |
| Chronometer, No. 156, when altitudes were taken..... | 16 | 38 | 1 | 16 | 38 | 1 | 16 | 38 | 1 |
| | 16 | 41 | 38 | 16 | 48 | 17 | 16 | 32 | 19 |
| Original errors ..... | + | 7 | 10 | + | 10 | 12 | + | 15 | 34 |
| | 16 | 48 | 48 | 16 | 58 | 29 | 16 | 47 | 53 |
| Accumulated rates ..... | + | 2 | 11 | — | 7 | 28 | + | 3 | 2 |
| Mean time at Greenwich by Chronometers ..... | 16 | 50 | 59 | 16 | 51 | 1 | 16 | 50 | 55 |
| Mean time at ship by altitudes... | 19 | 27 | 14 | 19 | 27 | 14 | 19 | 27 | 14 |
| Longitude in time..... | 2 | 36 | 15 | 2 | 36 | 13 | 2 | 36 | 19 |
| | ° | ′ | ″ | ° | ′ | ″ | ° | ′ | ″ |
| Longitude of ship..... | 39 | 3 | 45 | 39 | 3 | 15 | 39 | 4 | 45 E. |
| Longitude made to noon ..... | — | 10 | 0 | — | 10 | 0 | — | 10 | 0 W. |
| Longitude at noon ..... | 38 | 53 | 45 | 38 | 53 | 15 | 38 | 54 | 45 E. |

| | ° | ′ | ″ |
|---|---|---|---|
| Longitude by No. 156..... ..... | 38 | 56 | 45 |
| " " No. 284..... | 38 | 53 | 45 |
| " " No. 376..... | 38 | 53 | 15 |
| " " No. 807..... | 38 | 54 | 45 |
| | 4) | 218 | 30 |
| Mean Longitude at noon ..... | 38 | 54 | 37 E. |

*To find the Rate of a Chronometer or Timekeeper.*

When a chronometer is received from the maker, or person to whose care it has been entrusted to regulate its going, a memorandum is always given with it, stating how much it is fast or slow for mean time at the meridian of Greenwich, or any other given place, on a given day; and its daily rate of going, that is, its gain or loss in 24 hours mean time, in seconds and tenths of a second: these particulars should be entered in a book kept for the purpose of carrying on the sum of the daily rates, or the total gain or loss of the chronometer, to each day at noon; so that the accumulated rate may be readily known, without the trouble of calculating its amount every day of observation.*

Should the rate of a chronometer continue always uniform, the longitude is to be found as shewn in the preceding pages; but as these instruments are liable to vary their rates, it is necessary to examine their going whenever opportunities present themselves: and this may easily be done when the ship is in harbour, or in the same place two or three weeks, by taking a set of altitudes when the sun is at a proper distance from the meridian, from which the mean time at the place of observation may be obtained; the difference between which, and the mean of the times pointed out by the chronometer, will give what it is fast or slow at that meridian.

Immediately before the ship sails, repeat these observations, and find again how much the chronometer is fast or slow for mean time; the difference of these errors, when they are both of the same name, or their sum, when of contrary names, will be the whole gain or loss during the interval between the two observations: therefore to find the daily rate, say, as the interval of time is to 24 hours, so is the whole gain or loss, to the daily rate.

If the chronometer be fast at the time of the first observation, and the error be increasing, it is evidently gaining on mean time; but if decreasing, it is losing: on the contrary, if it be too slow at the time of the first observation, and the error increasing, it is losing; but if the error be decreasing, it is gaining.

The rate deduced from the comparison of the errors, is founded on the supposition, that the motion of the chronometer is uniform during the interval of time between the observations; but should that not be the case, these observations will not detect its irregularity: it will therefore be prudent to take the observations as frequently as circumstances will permit, by which several rates will be found, differing perhaps a little from each other; but the means of these may be considered as the true rate, and employed as such in subsequent observations for finding the longitude.

If any of the rates found as above, should differ materially from the rest, such rates should be altogether rejected, as probably arising from some error in the observations, or irregularities in the going of the chronometer.

When several observations are taken, by some of which the chronometer is found to be gaining, and by others losing, take the difference between

* Books ruled for this purpose may be had at the Publishers' of the present Work.

the sum of all the gainings, and the sum of all the losings, which divide by the number of days elapsed while it was under trial, and the quotient will be the mean rate, of the same denomination with the greater quantity.

The method of finding the rate of a chronometer by altitudes taken in the usual way, from the horizon of the sea, is well adapted to the practice of seamen; and if the observations be taken with care and skill, the rate so found, may be sufficiently exact for the usual length of a West India voyage: but it must be observed, that if there be an error in the daily rate, since that error accumulates every day, the longitude deduced from the chronometer at the end of a long interval, may in that case be wide of the truth.

The rate may, however, be found nearly as correct as with an astronomical clock, by equal or single altitudes taken on shore with a sextant and an artificial horizon: indeed, these two instruments may be considered a portable observatory, and a person with their assistance will be enabled to regulate chronometers wherever he may chance to stop a few days. And here we must remark, it is not necessary to take the chronometer on shore for that purpose; for if the observer have a good watch, that shews seconds, it may be compared with the chronometer immediately before he goes on shore; and the difference applied to the mean of the times pointed out by the assistant watch, when the altitudes are taken, will be the time by the chronometer, corresponding to the mean of the altitudes. In fact, the rate should always be ascertained, if possible, when the chronometer is on board ship, where being once fixed, it should on no account be removed;* for it has been found by experience, that the motion of a chronometer is generally accelerated after being received on board, whereby a losing rate will be diminished, and a gaining one increased: this effect has been ascribed to "the magnetic action exerted by the iron in the vessel on the inner rim of the balance, which is made of steel."†

When the motion of a chronometer is accelerated after its rate has been determined, the longitude resulting from observations made with it, will be to the westward of the true longitude; and when its motion is retarded, it will give the longitude too far to the eastward.

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* Chronometers should always be placed a-midships, and as nearly as possible to the ship's centre of motion; but at the same time at a distance from the iron-work of the ship.

Commander R. Owen, R. N., who has had considerable experience as a Navigator, recommends, as the least objectionable method of fixing chronometers, that of having a table hung on gimbols, with a weight of from 20 to 50 lbs. suspended underneath, in the manner of an azimuth compass, so that the centre of gravity be as near the centre of its motion as possible, to permit it to keep its level permanently, without being subject to vibrate, and the axes of the gimbols to work in smooth stuffed leather sockets, bearing against springs in every direction; these springs being neither too stiff, nor too sensible, for the weight they are to support. The pillars, or stand for the sockets, to be a fixture in the deck. The chronometers to be placed in small partitions on the table, and to be wedged securely in their places by soft cushions.

Commander O. also observes, that it is sometimes the practice to keep chronometers (particularly the small case ones) in drawers; but this is very objectionable, on account of the opening and shutting, which is sufficient of itself to derange them.

† See Mr. Fisher's Paper on the Errors in Longitude, as determined by Chronometers at Sea, read before the Royal Society, June 8, 1820.—Phil. Trans. 1820, p. 207.

We shall now proceed to illustrate the foregoing rules and remarks by a few Examples.

## EXAMPLE I.

October 2, a chronometer was 10m. 42. 8s. fast at noon for mean time at Greenwich; and October 11, at noon, it was 11m. 19. 7s. fast for the same meridian: required the daily rate of the chronometer.

| | | m. | s. | |
|---|---|---|---|---|
| October 2 | Chronometer was fast..... | 10 | 42.8 | |
| October 11 | " " fast..... | 11 | 19.7 | |
| Interval 9 days. | | 9) 0 | 36.9 | = gain in 9 days. |
| | Daily rate... | 0 | 4.1 | gaining. |

## EXAMPLE II.

At noon, June 13, a chronometer was 3m. 37s. fast for mean time at Greenwich; and at noon, June 25, it was 2m. 13. 8s. fast for the same meridian: required the daily rate of the chronometer.

| | | m. | s. | |
|---|---|---|---|---|
| June 13 | Chronometer was fast..... | 3 | 37.0 | |
| June 25 | " " fast..... | 2 | 13.8 | |
| Interval 12 days. | | 12) 1 | 23.2 | = loss in 12 days. |
| | Daily rate... | 0 | 6.9 | losing. |

## EXAMPLE III.

February 2, at noon, a chronometer was 1m. 10s. fast, and February 23, at noon, was 0m. 50s. slow, for Greenwich mean time: required the daily rate of the chronometer.

| | | m. | s. | |
|---|---|---|---|---|
| February 2 | Chronometer was fast ..... | 1 | 10 | |
| February 23 | " " slow..... | 0 | 50 | |
| Interval 21 days. | | 2 | 0 | = loss in 21 days. |
| | | 60 | | |
| | | 21) 120 | | |
| | Daily rate... | 5.7s. | | losing. |

## EXAMPLE IV.

November 5, by an observation taken at 4h. 20m. P. M., a chronometer was found to be 2h. 10m. 45s. slow; and on November 17, at 7h. 32m.

A. M. (civil time), it was 2h. 13m. 36s. slow at the same meridian: required the daily rate of the chronometer.

| | | | | | |
|---|---|---|---|---|---|
| November | 5 | at | 4h. 20m. | Chronometer was slow..... | 2h. 10m. 45s. |
| November | 16 | at | 19 32 | " " slow..... | 2 13 36 |
| Interval... | 11 days | | 15h. 12m. | Loss during the interval... | 0h. 2m. 51s. |

Then, As 11 days 15h. : 24 hours : : 2m. 51s. : 14. 7s.

Hence the daily rate of the chronometer is 14. 7s. losing.

## EXAMPLE V.

May 1, 1835, at Falmouth, in latitude 50° 9′ N., and longitude 5° 2′ W., at 18h. 45m. mean time (being May 2d, at 6h. 45m. A. M. civil time), the following altitudes were taken with an artificial horizon, for the purpose of ascertaining the daily rate of a chronometer which had been previously set to Greenwich mean time; the index error of the sextant being 1′ 35″ to be added.

| Times by Chron. | Double Alts. |
|---|---|
| h. m. s. | ° ′ ″ |
| 19 10 30 | 37 48 45 |
| 12 40 | 38 4 30 |
| 14 51 | 38 20 15 |
| 3) 38 1 | 114 13 30 |
| 19 12 40 | 38 4 30 |
| Index error ..... | + 1 35 |
| 2) 38 | 6 5 |
| Obs. alt. sun's L. L. | 19 3 2 |
| Sun's corr. (XVIII) | — 2 35 |
| | 19 0 27 |
| Sun's semidiameter | + 15 53 |
| Sun's true altitude. | 19 16 20 |
| | 90 |
| Sun's zenith dist.... | 70 43 40 |

| | m. | s. |
|---|---|---|
| Eq. of time, May 1 .. | 2 | 59.9 |
| Cor. for 19h. 5m. (LI.) | + | 6.1 |
| Eq. at Greenw. time . | 3 | 6.0 |

| | h. | m. | | |
|---|---|---|---|---|
| Time at Falmouth..... | 18 | 45 | | |
| Longitude in time..... | + 20 | W. | | |
| Time at Greenwich ..... | 19 | 5 | Log. 0996 | (XXXIII). |
| Variation of dec. in 24 hours | 19′ | 9″ | Log. 1213 | |
| | ° | ′ | ″ | |
| Variation in 19h. 5m.... | + 14 | 26 | Log. 2209 | |
| Sun's dec. at noon, May 1, | 14 | 56 | 35 N. (P. II. N. A.) | |
| Ditto at Greenw. time... | 15 | 11 | 1 N. | Secant 0.015431 |
| Latitude ..... | 50 | 9 | 0 N. | Secant 0.193291 |
| Difference..... | 34 | 57 | 59 | |
| Zenith distance ..... | 70 | 43 | 40 | |
| Sum ..... | 105 | 41 | 39 | 78 |
| Half-sum ..... | 52 | 50 | 49 | .....Sine... 9.901394 |
| Difference..... | 35 | 45 | 41 | 327 |
| Half-difference ..... | 17 | 52 | 50 | .....Sine... 9.486860 |
| | h. | m. | s. | |
| App. time from noon ... | 5 | 11 | 51 | .....Log... 9.59738. |
| | 24 | | | |
| App. time at Falmouth . | 18 | 48 | 9 | |
| Equation of time..... | — | 3 | 6 | |
| Mean time at Falmouth | 18 | 45 | 3 | |
| Ditto by chronometer... | 19 | 12 | 40 | |
| Chron. fast for meridian of Falmouth, May 1.. | 27 | 37 | | |

May 2d, 1835, at Falmouth, at 18h. 50m. mean time, (being May 3, at 6h. 50m. A. M. civil time), the following observations were taken with the same instruments as before, to find the daily rate of the chronometer.

| Times by Chron. | Double Alts. |
|---|---|
| h. m. s. | ° ′ ″ |
| 19 17 5 | 40 10 30 |
| 18 18 | 23 15 |
| 19 31 | 37 0 |
| 3) 54 54 | 70 45 |
| 19 18 18 | 40 23 35 |
| Index error ..... | + 1 35 |
| 2) | 40 25 10 |
| Obs. alt. sun's L. L. | 20 12 35 |
| Sun's corr. (XVIII) | − 2 26 |
| | 20 10 9 |
| Sun's semidiameter. | + 15 53 |
| Sun's true altitude. | 20 26 2 |
| | 90 |
| Sun's zenith dist.... | 69 33 58 |

| | m. | s. |
|---|---|---|
| Eq. of time, May 2... | 3 | 7.5 |
| Corr. for 19h. 10m. (LI) | + | 5.5 |
| Eq. at Greenw. time. | 3 | 13.0 |

| | h. | m. | | | |
|---|---|---|---|---|---|
| Time at Falmouth..... | 18 | 50 | | | |
| Longitude in time..... | + 20 | W. | | | |
| Time at Greenwich ..... | 19 | 10 | Log. | 0977 | (XXXIII). |
| Variation of dec. in 24 hours | 17′ | 54″ | Log. | 1274 | |
| | ° | ′ | ″ | | |
| Variation in 19h. 10m... | + | 14 | 18 | Log. | 2251 |
| Sun's dec. at noon, May 2, | 15 | 14 | 43 | N. | (P. II. N. A.) |
| | | | | | 1 |
| Ditto at Greenwich time | 15 | 29 | 1 | N. ..... Secant | 0.016054 |
| Latitude ..... | 50 | 9 | 0 | N. ..... Secant | 0.193291 |
| Difference..... | 34 | 39 | 59 | | |
| Zenith distance ..... | 69 | 33 | 58 | | |
| Sum ..... | 104 | 13 | 57 | | 95 |
| Half-sum ..... | 52 | 6 | 58 | ..... Sine... | 9.897123 |
| Difference ..... | 34 | 53 | 59 | | 395 |
| Half-difference..... | 17 | 26 | 59 | ..... Sine... | 9.476536 |
| | h. | m. | s. | | |
| App. time from noon ... | 5 | 6 | 0 | ..... Log... | 9.58350. |
| | 24 | | | | |
| App. time at Falmouth. | 18 | 54 | 0 | | |
| Equation of time..... | − | 3 | 13 | | |
| Mean time at Falmouth | 18 | 50 | 47 | | |
| Ditto by chronometer... | 19 | 18 | 18 | | |
| Chron. fast for meridian of Falmouth, May 2 . | 27 | 31 | | | |
| Ditto, May 1 . | 27 | 37 | | | |
| Daily rate of chronometer | 0 | 6 | losing. | | |

May 5, 1835, at Falmouth, at 18h. 45m. mean time (being May 6, at 6h. 45m. A. M. civil time), the following altitudes, with corresponding times, were taken with the same instruments as before, to find the daily rate of the chronometer.

| Times by Chron. | Double Alts. |
|---|---|
| h m. s. | ° ′ ″ |
| 19 5 59 | 38 4 0 |
| 7 12 | 19 28 |
| 8 22 | 34 44 |
| 3) 21 33 | 58 12 |
| 19 7 11 | 38 19 24 |
| Index error ..... | + 1 35 |
| 2) | 38 20 59 |
| Obs. alt. sun's L. L. | 19 10 29 |
| Sun's corr. (XVIII) | − 2 35 |
| | 19 7 54 |
| Sun's semidiameter | + 15 52 |
| Sun's true altitude. | 19 23 46 |
| | 90 |
| Sun's zenith dist. ... | 70 36 14 |

| | m. s. |
|---|---|
| Eq. of time, May 5 ... | 3 27.0 |
| Corr. for 19h. 5m. (LI) | + 4.3 |
| Eq. at Greenwich time | 3 31.3 |

| | h. m. | | |
|---|---|---|---|
| Time at Falmouth..... | 18 45 | | |
| Longitude in time..... | + 20 W. | | |
| Time at Greenwich ..... | 19 5 | Log. 0996 | (XXXIII). |
| Variation of dec. in 24 hours | 17′ 6″ | Log. 1472 | |
| | ° ′ ″ | | |
| Variation in 19h. 5m.... | + 13 36 | Log. 2458 | |
| ⊙'s dec. at noon, May 5, | 16 7 38 | N. (P. II. N. A.) | |
| Ditto at Greenw. time . | 16 21 14 | N.....Secant | 0.017928 |
| Latitude ..... | 50 9 0 | N.....Secant | 0.193291 |
| Difference..... | 33 47 46 | | |
| Zenith distance ..... | 70 36 14 | | |
| Sum .....104 | 24 0 | | |
| Half-sum ..... | 52 12 0 | .....Sine... | 9.897712 |
| Difference..... | 36 48 28 | | 89 |
| Half-difference..... | 18 24 14 | .....Sine... | 9.499204 |
| | h. m. s. | | |
| App. time from noon ... | 5 16 31.5 | .....Log.... | 9.60823. |
| | 24 | | |
| App. time at Falmouth . | 18 43 28.5 | | |
| Equation of time..... | − 3 31.3 | | |
| Mean time at Falmouth | 18 39 57.2 | | |
| Ditto by chronometer... | 19 7 11 | | |
| Chron. fast for meridian at Falmouth, May 5 . | 27 13.8 | | |
| Ditto, May 2 .... | 27 31 | | |
| Loss in 3 days .....3) | 0 17.2 | | |
| Daily rate of chronometer | 0 5.7 | losing. | |

May 7, 1835, at 18h. 35m. mean time, the altitude of the sun's lower limb, taken as before, and corrected for index error, was 18° 30′ 37″, when the chronometer shewed 19h. 0m. 3s., by which it will be found that the mean time at Falmouth was 18h. 33m. 2s. when the sun's altitude was observed; and the chronometer fast 27m. 1s.; which, compared with its error on May 5, gives its daily rate 6. 4s. losing.

Again, May 11, 1835, at 18h. 35m. mean time, the altitude of the sun's lower limb, taken as before, and corrected for index error, was 19° 2′ 23″, when the chronometer shewed 18h. 57m. 49s., which gives the error of the chronometer for the meridian of Falmouth, 26m. 35. 5s. fast, and the daily rate 6. 4s. losing.

From the preceding observations, the mean rate may be determined as follows:

| | | | m. | s. | | Daily rates. s. |
|---|---|---|---|---|---|---|
| May | 1 | Chronometer was fast... | 27 | 37 | | |
| " | 2 | " " fast... | 27 | 31 | .....loss in 1 day.... 6.0 | = 6.0 |
| " | 5 | " " fast... | 27 | 13.8 | .....loss in 3 days...17.2 ÷ 3 | = 5.7 |
| " | 7 | " " fast... | 27 | 1 | .....loss in 2 days...12.8 ÷ 2 | = 6.4 |
| " | 11 | " " fast... | 26 | 35.5 | .....loss in 4 days...25.5 ÷ 4 | = 6.4 |
| | | | | | Loss in 10 days...61.5 | 4) 24.5 |
| | | | | | Mean daily rate... | 6.12 |

Or 61. 5s., the total loss, divided by 10, the number of days elapsed between the first and last observations, gives the mean daily rate 6. 15s.

Hence it appears that on May 11, at 18h. 57m. 49s. (May 12, at 6h. 57m. 49s, A. M. civil time) the chronometer was fast for the meridian of Falmouth, 26m. 35. 5s., and losing daily 6. 12s.

Or if the longitude of Falmouth in time, (20m. 8s. W.) be added to 18h. 31m. 13. 5s., the mean time at Falmouth when the observation was made May 11, it will give the mean time at Greenwich 18h. 51m. 21. 5s., which, subtracted from 18h. 57m. 49s., shews that the chronometer was 6m. 27. 5s. fast for the meridian of Greenwich.

It is essential that the altitudes used for finding the rate of a chronometer should be observed about the same time of each day, or that the proportional part of the gain or loss should be found; for as the daily rate is the loss or gain in 24 hours, it follows, that if one observation, for instance, be taken in the morning, and another in the afternoon of the following day, the interval being more than a complete day of 24 hours, the difference of the times by the chronometer will be more than the daily rate. Let us suppose that the above series of observations were continued, and that on May 13, altitudes were taken in the afternoon, by which it appeared, the mean time at Falmouth was 5h. 16m. 20s. P. M. when the chronometer shewed 5h. 42m. 46. 5s., and was therefore 26m. 26. 5s. fast for mean time when the observations were taken.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| May 11d. | 18h. | 31m. | 13. 5s. | Chronometer was fast | | 26m. | 35. 5s. |
| May 13 | 5 | 16 | 20 | " | " | 26 | 26. 5 |
| Interval 1 | 10 | 45 | 6.5 | Difference | | 9 | |

The chronometer therefore lost 9s. in 1 day, 10h. 45m. = 34h. 45m. or 35 hours nearly: consequently, as 35h. : 9s. : : 24h. : 6. 2s., the daily rate required.

Three or more chronometers may be compared together daily, and a judgment thence formed of the regularity of their going: as for instance,

suppose the comparison be made each day about noon with three chronometers: the assumed rate of No. 1 being 2s. gaining; of No. 2, 5s. gaining; and of No. 3, 6s. losing; let the comparisons be made as in the following Tables:

*Comparison of No. 2. with No. 1.*

| Month | Days. | Chro. No. 1. | Chro. No. 2. | First Diff. | Sec. Diff. |
|---|---|---|---|---|---|
| | | h. m. s. | h. m. s. | m. s. | s. |
| May | 1 | 0 10 40 | 0 20 32 | 9 52 | |
| | 2 | 0 12 30 | 0 22 25 | 9 55 | 3 |
| | 3 | 0 15 20 | 0 25 18 | 9 58 | 3 |
| | 4 | 0 11 35 | 0 21 36 | 10 1 | 3 |
| | 5 | 0 13 5 | 0 23 9 | 10 4 | 3 |
| | 6 | 0 8 50 | 0 18 57 | 10 7 | 3 |
| | 7 | 0 14 45 | 0 24 55 | 10 10 | 3 |
| | 8 | 0 20 35 | 0 30 48 | 10 13 | 3 |
| | 9 | 0 15 10 | 0 25 26 | 10 16 | 3 |
| | 10 | 0 16 0 | 0 26 19 | 10 19 | 3 |

Daily gain of No. 1..... 2s.
Daily gain of No. 2..... 5

Daily diff. should be..... 3

*Comparison of No. 3. with No. 1*

| Month | Days. | Chro. No. 1. | Chro. No. 3. | First Diff. | Sec. Diff. |
|---|---|---|---|---|---|
| | | h. m. s. | h. m. s. | m. s. | s. |
| May | 1 | 0 11 10 | 0 6 45 | 4 25 | |
| | 2 | 0 13 0 | 0 8 27 | 4 33 | 8 |
| | 3 | 0 16 10 | 0 11 30 | 4 40 | 7 |
| | 4 | 0 11 55 | 0 7 9 | 4 46 | 6 |
| | 5 | 0 13 50 | 0 8 56 | 4 54 | 8 |
| | 6 | 0 9 15 | 0 4 14 | 5 1 | 7 |
| | 7 | 0 15 20 | 0 10 10 | 5 10 | 9 |
| | 8 | 0 20 50 | 0 15 32 | 5 18 | 8 |
| | 9 | 0 15 55 | 0 10 31 | 5 24 | 6 |
| | 10 | 0 16 40 | 0 11 7 | 5 27 | 3 |

Daily gain of No. 1..... 2s.
Daily loss of No. 3..... 6

Daily diff. should be..... 8

*Comparison of No. 3. with No. 2.*

| Month | Days. | Chro. No. 2. | Chro. No. 3. | First Diff. | Sec. Diff. |
|---|---|---|---|---|---|
| | | h. m. s. | h. m. s. | m. s. | s. |
| May | 1 | 0 21 30 | 0 7 43 | 13 47 | |
| | 2 | 0 23 25 | 0 9 27 | 13 58 | 11 |
| | 3 | 0 26 10 | 0 12 2 | 14 8 | 10 |
| | 4 | 0 22 35 | 0 8 18 | 14 17 | 9 |
| | 5 | 0 24 10 | 0 9 43 | 14 27 | 10 |
| | 6 | 0 19 55 | 0 5 19 | 14 36 | 9 |
| | 7 | 0 25 10 | 0 10 22 | 14 48 | 12 |
| | 8 | 0 31 0 | 0 16 1 | 14 59 | 11 |
| | 9 | 0 26 10 | 0 11 2 | 15 8 | 9 |
| | 10 | 0 27 35 | 0 12 15 | 15 20 | 12 |

Daily gain of No. 2..... 5s.
Daily loss of No. 3..... 6

Daily diff. should be .....11

Now by comparing No. 2 with No. 1, we find that No. 2 is regularly gaining daily 3s. on No. 1, equal to the difference of their rates; again, No. 3 being compared with No. 1, their daily difference (which should be 8s., the sum of their daily rates, because one is gaining, and the other losing) appears to be irregular; and, lastly, No. 3 compared with No. 2, gives also irregular differences, which should be 11s., the sum of their rates: hence we conclude that No. 1 and No. 2 are going steadily, but that No. 3 is going very indifferently.

In winding up a chronometer that is going, great caution should be observed, not to give it circular motion, which would alter its rate some seconds, or, perhaps, even stop its going; but when a chronometer is once suffered to run down, it will not acquire new motion without giving it two or three quick horizontal circular turns; and it must be observed, that when it has once stopped, though for ever so short a period, it will not recover the regularity of its motion for some days after, and consequently no reliance can be placed on its performance, until its rate be proved by subsequent observations.

A chronometer should be wound up regularly at the same time of the day, and great care taken not to give the key, first half a turn, then a whole turn, afterwards three-quarters, and so on; for this irregular mode of winding up will sometimes very materially alter its rate, and should be as carefully avoided as circular motion: it is therefore advisable always to to turn the key gently half round at a time, until the spring be wound up. The chronometer should also be examined before the case is shut, to ascertain whether it continue going, as sometimes, when wound up in haste, and the chain overstrained, it will be liable to stop.

Chronometers are of great utility in carrying on the longitudes deduced from lunar distances, from one day to another, so that the results of a number of observations may be brought to one point of time. Also, the apparent time found by altitudes taken at a proper distance from the meridian, being carried on by the chronometer, will answer for any lunar observation taken in the course of 24 hours: in fact, whenever it is requisite to measure short intervals of time accurately, or to ascertain the difference of longitude between adjacent places, these instruments are of the greatest importance.

The method of carrying on or deducing the time of taking distances, to the time of taking altitudes for the chronometer, may be illustrated as follows: suppose that altitudes are taken for ascertaining the longitude by chronometers, and that afterwards a set of lunar distances be observed; take the elapsed time, as measured by the chronometer, from observing the time-altitudes to that of observing the distances, and when the time at Greenwich is deduced from the distances, subtract this elapsed time from it, and the remainder will be the time at Greenwich when the altitudes for time were taken, and will produce the longitude at that time, and not when the distances were observed. On the contrary, if a set of lunar distances be taken before the altitudes are observed to find the apparent time, then the elapsed time must be added to the Greenwich time, to bring the longitude to the time when the altitudes were taken.

Or, which is precisely the same thing, ascertain by the altitudes how much the chronometer is too fast or too slow at the meridian of the place of observation: this error being applied to the mean of the times by the same chronometer, when the distances are observed, will reduce the longitude by the lunar observation to the meridian where the error was ascertained; consequently, will give the longitude of the ship when the time-altitudes were observed.

## EXAMPLE.

March 16, 1835, a set of altitudes was taken, which gave the mean time at ship 4h. 48m. 39s., when a chronometer, having no rate, shewed 2h. 48m. 59s.; and at 7h. 35m. 50s. by the same chronometer, a set of distances was observed, which gave mean time at Greenwich 7h. 28m. 38s.: required the longitude of the ship when the time-altitudes were taken for the chronometer (see Example V. on lunar observations).

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean time by chronometer when the time-altitudes were observed | 2 | 48 | 59 | |
| Mean time by chronometer when the distances were observed ... | 7 | 35 | 50 | |
| Interval by chronometer ..... | 4 | 46 | 51 | |
| Mean time at Greenwich when the distances were observed ..... | 7 | 28 | 38 | |
| Mean time at Greenwich when time-alts. were taken for chron... | 2 | 41 | 47 | |
| Mean time at ship when time-alts. were taken for chronometer ... | 4 | 48 | 39 | |
| Longitude when time-altitudes were taken for chronometer ..... | 2 | 6 | 52 | = 31° 43′ East. |

OR THUS,

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean time by chronometer when the time-altitudes were observed | 2 | 48 | 59 | |
| Mean time at ship when time-altitudes were taken for chron..... | 4 | 48 | 39 | |
| Chronometer slow at the meridian of the ship ..... | 1 | 59 | 40 | |
| Mean time by chronometers when the distances were observed ... | 7 | 35 | 50 | |
| Mean time at the meridian where the altitudes were taken, when the distances were observed ..... | 9 | 35 | 30 | |
| Mean time at Greenwich when the distances were observed ..... | 7 | 28 | 38 | |
| Longitude when time-altitudes were taken for chronometer ..... | 2 | 6 | 52 | = 31° 43′ East. |

Observations of lunar distances may be carried on from one time to another, so that when the observer has obtained a number of sets on each side of the moon, he may bring them all to one point of time by the chronometer, and thereby get a mean of all the observations, which will give very nearly the true longitude, if the observations be carefully made. This may be explained as follows: suppose on January 20, six sets of lunar distances be observed; on the 21st, four more; and on the 23d, being the last day when the distances are set down in the Nautical Almanac on that side of the moon, six more sets be observed. Bring each set of distances to the time when the altitudes for chronometers were taken on their respective days; then take the difference of longitude shewn by the chronometer between the 20th and the 23d, at the time the altitudes for the chronometer were observed, which apply to each set taken on the 20th; do the same between the 21st and 23d; each set will then be brought on to the time when altitudes for the chronometer were taken on the 23d; in all sixteen sets. The mean of these observations will, in all probability, not be far from the truth. In this manner observations may be carried on, by distances taken on the other side of the moon, and the result deduced from their mean, will approximate still nearer to the truth. Thus

the lunar observations and chronometers may be made to go hand in hand with each other, to discover the ship's true longitude.

## EXAMPLES FOR EXERCISE.

1. July 8, 1835, P. M., in latitude 47° 46′ N., the observed altitude of the sun's lower limb was 26° 32′ 17″, when a chronometer shewed 2h. 50m. 15s. P. M., whose error and rate had been determined at noon, June 25, when it was fast for Greenwich mean time 2m. 13. 8s., and losing 6. 9s. daily; the error of the sextant being + 5′ 10″, and the height of the observer's eye 28 feet: required the longitude of the ship.

Answer. Mean time at ship 5h. 2m. 24s.; mean time at Greenwich 2h. 49m. 32s.; and the longitude 33° 13′ 0″ East.

2. October 11, 1835, at noon, a chronometer was fast for Greenwich mean time 11m. 19. 4s., and was gaining 4. 1s. per day.

October 21, A. M. (civil time), in latitude 34° 37′ S., the same chronometer shewed 6h. 42m. 10s. A. M. (civil time) at Greenwich, when the observed altitude of the sun's lower limb was 42° 19′ 52″; the index error being 2′ 30″ to subtract, and the height of the eye 20 feet: required the longitude.

Answer. Mean time at ship, October 20, 20h. 44m. 44s.; mean time at Greenwich 18h. 30m. 11s.; and the longitude 33° 38′ 15″ E.

3. August 7, 1835, at noon, a chronometer was slow for mean time at Greenwich 17m. 30s.; and on August 13, at noon, it was slow for mean time, at the same meridian, 18m. 45s.

August 23, A. M. (civil time), in latitude 37° 40′ N., when the above chronometer shewed 5h. 53m. 16s. (being P. M. at Greenwich), the observed altitude of the sun's lower limb was 37° 15′ 40″, the index error of the sextant being 2′ 15″, to subtract, and the height of the observer's eye 20 feet: required the longitude.

Answer. The daily rate of the chronometer was 12. 5s. losing; the mean time at ship 20h. 37m. 24s.; and the mean time at Greenwich 30h. 14m. 9s. past noon, August 22; the longitude 144° 11′ 15″ West.

4. January 2, 1835, at noon, a chronometer was 1h. 12m. 52. 5s. slow for mean time at Greenwich; and on January 9, at noon, it was 1h. 13m. 57s. slow for mean time at the same meridian.

January 30, P. M., in latitude 30° 20′ N., when the above chronometer shewed 2h. 39m. 51s. (being January 30, A. M., civil time, at Greenwich), the observed altitude of the sun's lower limb was 17° 42′ 54″, the index error being 3′ 15″ to add, and the height of the eye 20 feet: required the longitude.

Answer. The daily rate of the chronometer was 9. 2s. losing; the mean time at ship 27h. 56m. 26s.; and the mean time at Greenwich 15h. 56m. 58s. past noon, January 29; the longitude 179° 52′ 0″ E.

5. February 6, 1835, at noon, a chronometer was 27m. 54. 5s. fast for mean time at the Cape of Good Hope, in longitude 18° 24′ 24″ E.; and February 13, at noon, it was 29m. 10s. fast, at the same meridian.

March 3, about 5h. 58m. P. M., being in latitude 48° 57′ N., the altitude of the Star Regulus was observed to be 17° 42′ 16″ East of the meridian, when the above chronometer shewed 3h. 10m. 36s. P. M.; the error of the sextant being + 2′ 10″, and the height of the observer's eye 25 feet: required the longitude.

Answer. The daily rate of the chronometer was 10. 8s. gaining; the mean time at ship 6h. 6m. 12s.; the mean time at Greenwich 1h. 24m. 32s.; and the longitude 70° 25′ 0″ East.

6. December 10, 1834, at noon, a chronometer was 10m. 46s. fast for mean time at Greenwich, and losing daily 12. 5s.

January 3, 1835, in latitude 21° 20′ N., the same chronometer shewed 9h. 11m. 54s. P. M., when the observed altitude of the centre of the planet Jupiter was 48° 3′ East of the meridian; the index error of the sextant being + 4′ 15″, and the height of the observer's eye 18 feet: required the true longitude of the ship.

Answer. Longitude of the ship, 48° 39′ 45″ West.

7. April 2, 1835, at noon, a chronometer was slow for mean time at the Observatory of Paramatta (New South Wales), in longitude 151° 1′ 34″ E., by 9h. 34m. 10s., and was losing daily 5. 8s.

May 20, 1835 (civil time), being in latitude 42° 36′ S., and longitude by account 116° 30′ E., when the above chronometer shewed 4h. 8m. 14s. A. M., the observed altitude of the moon's upper limb was 24° 34′ 15″ West of the meridian; the error of the instrument being — 2′ 30″, and the height of the observer's eye 21 feet: required the true longitude of the ship.

Answer. The longitude of the ship, 116° 20′ 30″ East.

8. September 9, 1835 (civil time), at Bombay, in latitude 18° 56′ N., and longitude 72° 54′ 24″ E., about 7h. 12m. A. M., the double altitude of the sun's lower limb was observed to be 38° 37′ 55″ by an artificial horizon, when a chronometer shewed 2h. 31m. 58s. A. M.; and on September 16, about 7h. 4m. A. M., the double altitude of the sun's lower limb was again observed to be 33° 42′, when the same chronometer shewed 2h. 23m. 54s. A. M., the error of the sextant being — 2′ 10″: required the rate of the chronometer, and its error on Greenwich mean time, when the latter altitude was observed.

Answer. The chronometer was 11m. 9. 5s. fast for Greenwich mean time, September 9, and 12m. 24s. fast on September 16; hence the daily rate was 10. 6s. gaining.

9. May 4, 1835, at Kingston, Jamaica, in latitude 17° 58′ N., and longitude 76° 46′ 10″ W., about 4h. 30m. P. M., the double altitude of the sun's lower limb, taken by an artificial horizon, was 49° 34′ 35″, a chronometer, No. 65, shewing at the same time 9h. 30m. 28s. P. M.; and on May 12, about 4h. 31m. P. M., the double altitude of the sun's lower limb was 49° 35′ 50″, when No. 65 shewed 9h. 31m. 51s. P. M.; the index error of the sextant being + 1′ 15″: required the rate of the chronometer, and its error for Greenwich mean time when the latter altitude was taken.

Answer. The chronometer was 6m. 23s. slow for mean time at Greenwich on May 4, and 6m. 26s. slow on May 12; hence the daily rate was 0. 4s. losing.

# ON FINDING THE LONGITUDE BY LUNAR OBSERVATIONS.

## *To find the apparent Altitudes and Distance.*

RULES.—1. With the apparent time at the ship, and the longitude by account turned into time (XIX)., find the apparent time at Greenwich by the Rules in Page 155; to which apply the equation of time, as directed in Page 153: the result will be the mean time at Greenwich by account. But, should a chronometer be at hand, whose original error and rate are known, the mean time at Greenwich may be more correctly and easily inferred from it, as shewn in the method of finding the longitude by chronometers.

2. From Page III. of the month in the Nautical Almanac, take out the moon's semidiameter and horizontal parallax, and reduce them to the mean time at Greenwich*; and to the semidiameter add the moon's augmentation, taken from Table VII.

3. From the moon's observed altitude† subtract the dip of the horizon (V.), and to the remainder add the moon's augmented semidiameter when the lower limb is observed, or subtract it if the upper limb be taken: the result will be the apparent altitude of the moon's centre.

4. Then, *if the sun be observed*, from the observed altitude of the lower limb subtract the dip of the horizon (V.), and to the remainder add the sun's semidiameter for the given day, taken from Page II. of the month in the Nautical Almanac: the sum will be the sun's apparent altitude.

5. To the observed distance add the semidiameter of the sun, and the moon's augmented semidiameter; their sum will be the apparent distance.

6. But, *if a star or a planet be observed*, from its observed altitude subtract the dip; and the remainder will be the star's or planet's apparent altitude.

7. To the observed distance of the moon and star, or planet, add the moon's augmented semidiameter, if the nearest limb were taken, but subtract it, if the farthest limb were observed: their sum or difference will be the apparent distance.

## *To find the true Distance.*‡

### METHOD I.

RULES.—1. To the sum of the apparent altitudes add the difference of the correction of the moon's apparent altitude (XXX.), and that of the sun,

* See Note, Page 186.

† In all cases the observed altitudes and distances must *first* be corrected for the index error (if any) of the instrument.

‡ Five different methods of clearing the distance are here given: the first is a modification of Mr. Krafft's Method by natural versed Sines; the second is derived from that of M. Borda, abridged by the Table of Logarithmic Differences, and requires six places of figures in the logarithms; the third is similar to that given by Mr. Witchell, and requires only four places of figures; the fourth was invented by Mendoza Rios, Esq., and has the advantage of not requiring any distinction of cases; the fifth is Mr. Lyon's, improved by using a set of *Lunar Tables*, invented and published by the Author of this Work. These Tables, for correcting the apparent distance for the effect of refraction without calculation, render this method one of the easiest and shortest that have been proposed.

star, or planet*, which will give the sum of their true altitudes; subtract this from 180°, and the remainder will be the sum of their true zenith distances.

2. Under the sum of the apparent altitudes place the auxiliary arc (XXX*.)† and the apparent distance: call these A, B, and C.

3. Find the sum and difference of the auxiliary arc (B), and the sum of the apparent altitudes (A), also the sum and difference of the auxiliary arc (B), and the apparent distance (C); place these in order under each other, together with the sum of the true zenith distances.

4. Add together the natural versed sines (XXXVI). of the five arcs, placing the parts for seconds opposite each, and their sum, together with the sum of the parts, will be the natural versed sine of the true distance.

NOTE. 1. Since the true distance will never differ much more than a degree from the apparent distance, it will suffice to take out only the last five figures of the natural versed sines, observing to reject the tens in the last line added up.

2. When any of the arcs exceed 180°, subtract them from 360°, and take out the natural versed sine of the remainder.

## METHOD II.

RULES.—1. To the sum of the apparent altitudes add the difference of the correction of the moon's apparent altitude (XXX.), and that of the sun, star, or planet*, which will give the sum of their true altitudes, of which take the half.

2. Add together the apparent altitudes and apparent distance, and find the difference between half this sum and the apparent distance.

3. To the log. co-sines of the half-sum and difference (XXV.) add the logarithmic difference (XXXIX.)‡, and half the sum of these three logarithms will be the log. sine of an arch.

4. Add together the log. co-sines of the sum and difference of the arch, and half the sum of the true altitudes; then will half the sum of these two logarithms be the log. sine of half the true distance.

NOTE. In this method it may be observed that the seconds of the apparent distance may be omitted until the operation be finished, and then they are to be added to the computed distance. If the sum of the apparent distance and altitudes should have an odd digit in the unit's place of the minutes, the minutes in the distance may be increased by an unit; and, in this case, what the given number of seconds wants of 60″, is to be subtracted from the computed distance.

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* The *sun's* correction is the difference of the refraction (IV.) and parallax in altitude (VI.), which may be found at once in Table XVIII. The *star's* correction is the refraction in altitude (IV. or XVIII.) The *planet's* correction is the difference of the refraction (IV.) and parallax in altitude (XLVIII.)

† The auxiliary arc may be taken out at the same time with the moon's correction, being placed on the opposite page, taking care always to add the seconds given in the right-hand column, when the distance from the sun or a star be observed; or those in Table L. when the object is a planet

‡ When the sun or a star is observed, the logarithmic difference is to be corrected by Table XL. or XLI.; but when the object is a planet, by Table XLIX.

## METHOD III.

RULES.—1. Add the sun's, star's, or planet's apparent altitude to the moon's apparent altitude, and take half their sum; subtract the less altitude from the greater, and take half the difference; then add together

the log. co-tangent of half the sum (XXV.);
the log. tangent of half the difference;
and the log. co-tangent of half the apparent distance:

their sum, rejecting the tens in the index, will be the log. tangent of an arch, which call A.

2. When the sun's, star's, or planet's altitude is greater than the moon's, take the difference between the arch A, and half the apparent distance; but if less, take their sum; then add together

the log. co-tangent of this sum or difference;
the log. co-tangent of the sun's, star's, or planet's apparent altitude;
and the proportional logarithm (XXXIV.) of the sun's, star's, or planet's correction*;

their sum, rejecting the tens in the index, will be the proportional logarithm of the *first correction*.

3. If the sum of the arch A, and half the apparent distance, were taken in the preceding article, now take their difference; but if their difference were then taken, now take their sum; then add together

the log. co-tangent of this sum or difference;
the log. co-tangent of the moon's apparent altitude;
and the proportional log. (XXXIV.) of the moon's correction (XXX.);

their sum, rejecting the tens in the index, will be the proportional logarithm of the *second correction*.

4. When the arch A is less than half the apparent distance, the first correction must be added to, and the second correction subtracted from the apparent distance; but when the arch A is greater, both the first and second corrections are to be added to the apparent distance, if the moon's altitude be the greater; but when the moon's altitude is the less, they are both to be subtracted from it, to give the corrected distance.

5. Enter Table XXXV. with the corrected distance at the top or bottom, and the moon's correction and second correction alternately in the side column: the difference between the seconds thus taken out, being added to the corrected distance, when it is less than 90°, or subtracted from it when above, will give the true distance.

## METHOD IV.

RULES.—1. Add together the apparent distance and apparent altitudes, and take half their sum; the difference between the half-sum and the sun's, star's, or planet's apparent altitude, call the *first remainder*; and the difference between the half-sum and the moon's apparent altitude, call the *second remainder*.

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* See Note * at the bottom of the preceding Page.

2. Add together
the log. sine of the apparent distance;
the log. co-sine of the moon's apparent altitude;
the log. secant of the half-sum;
the log co-secant of the first remainder;
the proportional log. (XXXIV.) of the moon's correction (XXX.);
and the constant logarithm 9.6990:
their sum, rejecting the tens in the index, will be the proportional logarithm of the first correction.

3. Add together
the log. sine of the apparent distance (already found);
the log. co-sine of the sun's, star's, or planet's apparent altitude;
the log. secant of the half-sum (already found);
the log. co-secant of the second remainder;
the proportional log. (XXXIV.) of the sun's, star's, or planet's correction*;
and the constant logarithm 9.6990:
their sum, rejecting the tens in the index, will be the proportional logarithm of the second correction.

4. The difference between the first correction and the correction of the moon's altitude, call the difference of corrections.

Enter Table XXXV. with the apparent distance at the top, and the moon's correction in the side column, and the corresponding number will be the third correction; in the same column, and opposite the difference of corrections, will be found the fourth correction.

5. Subtract the sum of the moon's correction, and the second and fourth corrections, from the apparent distance; to the remainder add the sun's, star's, or planet's correction, and the first and third corrections: their sum will be the true distance.

METHOD V

1. To the apparent distance add the correction taken from the Linear Tables; the sum will be the distance corrected for refraction.

2. Add together the sine of the corrected distance (XXV.), the co-secant of the sun's, star's, or planet's apparent altitude, and the proportional logarithm (XXXIV.) of the moon's horizontal parallax; the sum, rejecting 20 in the index, will be the proportional logarithm of the *first arch.*

3. Add together the tangent of the corrected distance, the co-secant of the moon's apparent altitude, and the proportional logarithm of the moon's horizontal parallax; the sum, rejecting 20 in the index, will be the proportional logarithm of the *second arch.*

4. *When the distance is less than* 90°, the difference of the first and second arches is a *correction for parallax*; which, subtracted from the corrected distance when the first arch is the greater, or added to it when the first arch is the less, the sum or remainder will be the distance corrected for the moon's parallax.

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* See Note * at the bottom of Page 267.

But, *when the distance is greater than* 90°, the sum of the two arches is a *correction for parallax*, and is always to be subtracted from the corrected distance.

5. Enter Table XXXV., and from the column marked with the distance at the top, opposite the moon's parallax in altitude* in the left side column, take out a number of seconds answering thereto; then in the column with the distance at the top, opposite the correction for parallax, find another number of seconds; the difference between these being added to the distance corrected for refraction and parallax, when it is less than 90°, or subtracted from it when above, the sum or remainder will give the true distance.

NOTE. If the moon's distance from the *sun* be observed, it may be further corrected for the parallax of the latter by Table A. (Linear Tables), which gives two small corrections, to be found under the apparent altitudes, and opposite the distance, to be applied as directed at the head of the column containing the distance†. It may, however, be observed that the error, arising from the omission of these corrections, will seldom amount to more than two or three seconds, and in no case can exceed nine seconds; they therefore need only be applied when the distance is required to the nearest second.

But if the moon's distance be taken from the centre of the Planets *Venus* or *Mars*, it should be corrected for the effect of their parallax, by entering Table A with the distance and altitudes, as directed for the sun, using the altitudes of the planet instead of that of the sun; then multiply the correction so found by the horizontal parallax of the planet‡, and divide the product by 9: the quotient will be the correction for the planet's parallax, to be applied to the distance by addition or subtraction, as directed for the sun. The parallaxes of the Planets *Jupiter* and *Saturn* are too small to require notice.

### *Having the true Distance, to find the Longitude.*

1. Among the distances of the moon's centre from the sun, a star, or planet, set down for every third hour of Greenwich time, from Page XIII. to XVIII. of each month in the Nautical Almanac, find the two distances between which the true distance falls on the given day of the month at Greenwich, and take out the intermediate proportional logarithm from the column headed "P. L. of Diff."; subtract this prop. log. from the prop. log. (XXXIV.) of the difference between the true distance and that under the next less hour; the remainder will be the prop. log. of a portion of time, which added to the above-mentioned next less hour, the sum will be the mean time at Greenwich.

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* The moon's parallax in altitude is found by Table B. (Linear Tables), under the moon's horizontal parallax, and opposite the moon's altitude.

† When both corrections are additive or subtractive, their sum is to be added or subtracted; but if one be additive, and the other subtractive, their difference is to be added or subtracted according to that of the greater.

‡ The horizontal parallaxes of the planets are given in the Nautical Almanac for 1835 from Pages 359 to 361.

But, as the distances in the Almanac do not increase or decrease uniformly, on account of the irregularity of the moon's motion, when extreme accuracy is desired, a number of seconds should be applied to the above Greenwich time (especially when the prop. logs., opposite the distances in the Almanac, increase or decrease by considerable differences), which may be found as directed in the Explanation to Table LIV.; or by a Table given in Page 500 of the Almanac for 1835.

2. Find the difference between the mean time at Greenwich and the mean time at the ship*; convert this difference into degrees and minutes (XIX.), and it will give the true longitude of the ship: East, if the time at the ship be *greater* than the time at Greenwich (reckoning from noon of the same date); but West, if the time at the ship be *less* than the time at Greenwich.

## EXAMPLE I.

June 3, 1835, in latitude 13° 29′ N., and longitude by account 57° 15′ E., about 4h. P. M. apparent time, the angular distance between the sun and moon was observed to be 79° 28′ 15″, the altitude of the sun's lower limb being 32° 47′ 30″; the altitude of the moon's upper limb 65° 55′ 20″; and the height of the observer's eye 18 feet: required the true longitude of the ship.

| | h. m. | | ′ ″ |
|---|---|---|---|
| Estimated apparent time at ship..... | 4 0 | Moon's semidiam. at noon, June 3... | 15 37 |
| Longitude by account, in time ..... | 3 49 E. | Moon's augmentation (VII.) ..... | + 15 |
| Estimated appar. time at Greenwich. | 0 11 | Moon's augmented semidiameter | + 15 52 |
| Equation of time (P. I. N. A.) ..... | — 2 | Sun's semidiameter (P. II. N. A.) | + 15 47 |
| Estimated mean time at Greenwich.. | 0 9 | Observed distance ..... | 79 28 15 |
| Moon's hor. par. at noon, June 3... | 57′ 20″ | Apparent distance ..... | 79 59 54 |

| | ° ′ ″ | | ° ′ ″ |
|---|---|---|---|
| Obs. altitude of sun's lower limb | 32 47 30 | Obs. alt. of moon's upper limb... | 65 55 20 |
| Dip of horizon..... | — 4 4 | Dip of horizon..... | — 4 4 |
| | 32 43 26 | | 65 51 16 |
| Sun's semidiameter ..... | + 15 47 | Moon's augmented semidiameter | — 15 52 |
| Sun's apparent altitude ..... | 32 59 13 | Moon's apparent altitude ..... | 65 35 24 |

* If either of the objects employed in the lunar observation be far enough from the meridian, the time at the ship is to be found from its altitude by the Rules in Pages 230, 233, 236, or 238; but if both these be too near the meridian, or the altitudes cannot well be depended on, (although they may be sufficiently exact for clearing the distance), the time at the ship, and thence the error of the watch or chronometer, must be found either before or after the distance is taken, and the error applied to the mean of the times given by the same watch, when the distance is observed (as in the fourth and fifth Examples); and it must be understood that in this case the longitude deduced from the lunar observation, will be that of the ship, at the time the error of the watch was ascertained.

## *To find the true Distance.*

### METHOD I.

| | (XXX.) ′ ″ | | (XXX.ª) ° ′ ″ |
|---|---|---|---|
| ☽'s app. alt. 65° 30′, and hor. par. 57′. | 23 2 | | 60 28 50 |
| Parts for 5′ altitude | + 6 | | + 1 |
| Ditto for 20″ parallax | + 8 | | + 10 |
| | | Parts for sun's app. altitude 33°... | + 3 |
| Moon's correction | 23 16 | | |
| | | Auxiliary arc | 60 29 4 |

| | ° ′ ″ | | ° ′ ″ |
|---|---|---|---|
| Sun's apparent altitude | 32 59 13 | Sum of apparent altitudes | 98 34 37 |
| Moon's apparent altitude | 65 35 24 | Moon's corr. (XXX.) 23′ 16″ / Sun's corr. (XVIII.) 1 20 | + 21 56 |
| Sum of app. altitudes (A) | 98 34 37 | Sum of true altitudes | 98 56 33 |
| Auxiliary arc (B) | 60 29 4 | | 180 |
| Apparent distance (C) | 79 59 54 | Sum of true zenith distances | 81 3 27 |

| | | | |
|---|---|---|---|
| Sum of A and B | 159 3 41 | Versed | 33893 parts for seconds 70 |
| Diff. of ditto | 38 5 33 | Versed | 12886 100 |
| Sum of B and C | 140 28 58 | Versed | 71254 180 |
| Diff. of ditto | 19 30 50 | Versed | 57358 82 |
| Sum of true zenith dists. | 81 3 27 | Versed | 44427 130 |
| | | | 562 Sum of parts 562 |
| True distance | 79 39 9 | Versed | 20380 |

### METHOD II.

| | ° ′ | | ° ′ | | |
|---|---|---|---|---|---|
| Sun's app. altitude | 32 59 | | 32 59 | | |
| Moon's app. altitude | 65 35 | | 65 35 | | |
| | | Apparent distance | 80 0 | | |
| Sum of app. altitudes | 98 34 ″ | | | | |
| Moon's corr. 23′ 16″ / Sun's corr. 1 20 | + 21 56 | Sum | 178 34 | Log. difference | 9.993575 |
| | | Half-sum | 89 17 | Co-sine | 8.097183 |
| | | Diff. of do. and app. dist. | 9 17 | Co-sine | 9.994274 |
| Sum of true altitudes | 98 55 56 | | | | 2) 18.085032 |
| Half-sum | 49 27 58 | | | | |
| Arch | 6 19 54 | | | Sine | 9.042516 |
| Sum | 55 47 52 | | | Co-sine | 9.749826 |
| Difference | 43 8 4 | | | Co-sine | 9.863175 |
| | | | | | 2) 19.613001 |
| | ° ′ ″ | | | | |
| | 39 49 37 | | | Sine | 9.806500 |
| | × 2 | | | | |
| | 79 39 14 | | | | |
| Seconds increased | — 6 | | | | |
| True distance | 79 39 8 | | | | |

## METHOD III.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sun's apparent altitude.. | 32°59′ | | | | | | | |
| Moon's apparent altitude | 65 35 | | | | | | | |
| | | | | | ° | ′ | | |
| Sum | 98 34 | | Half | | 49 | 17 | Co-tangent... | 9.9348 |
| Difference | 32 36 | | Half | | 16 | 18 | Tangent | 9.4660 |
| Apparent distance | 79 59 | 54″ | Half | | 40 | 0 | Co-tangent... | 0.0762 |
| First correction | + 1 | 19 | | | | | | |
| | | | Arch A | | 16 | 42 | Tangent | 9.4770 |
| | 80 1 | 13 | | | | | | |
| Second correction | — 22 | 4 | Sum | | 56 | 42 | Co-tangent... | 9.8175 |
| | | | Sun's apparent altitude.. | | 32 | 59 | Co-tangent... | 0.1878 |
| | 79 39 | 9 | Sun's correction | | 1′ | 20″ | P. Log. | 2.1303 |
| Third correction | 0 | | | | | | | |
| | | | First correction | | 1 | 19 | P. Log. | 2.1356 |
| True distance | 79 39 | 9 | | | | | | |
| | | | Difference | | 23° | 18′ | Co-tangent... | 0.3659 |
| | | | Moon's apparent altitude | | 65 | 35 | Co-tangent... | 9.6570 |
| | | | Moon's correction | | 23′ | 16″ | P. Log. | 0.8885 |
| | | | Second correction | | 22 | 4 | P. Log. | 0.9114 |

## METHOD IV.

| | ° | ′ | | | | | ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|
| Apparent distance | 80 | 0 | Sine | 9.9934 | | 9.9934 | Moon's corr. | — 23 | 16 |
| Moon's app. altitude... | 65 | 35 | Co-sine | 9.6163 | | | Second corr. | — | 1 |
| Sun's apparent altitude | 32 | 59 | Co-sine | | | 9.9237 | Fourth corr. | — | 1 |
| Sum | 178 | 34 | | | | | Sum | — 23 | 18 |
| | | | | | | | App. distance.. | 79 59 | 54 |
| Half-sum | 89 | 17 | Secant | 1.9028 | | 1.9028 | | | |
| First remainder | 56 | 18 | Co-secant | 0.0799 | | | | 79 36 | 36 |
| Second remainder | 23 | 42 | Co-secant | | | 0.3958 | Sun's corr. | + 1 | 20 |
| Sun's correction | 1′ | 20″ | P. Log. | | | 2.1303 | First corr. | + 1 | 11 |
| Moon's correction | 23 | 16 | P. Log. | 0.8885 | | | Third corr. | + | 1 |
| | | | Const. Log. | 9.6990 | | 9.6990 | | | |
| | | | | | | | True distance.. | 79 39 | 8 |
| First correction | 1 | 11 | P. Log. | 2.1799 | P.L. | 4.0450 | Second corr. | 1″ | |
| Diff. of correction | 22 | 5 | | | | | | | |

## METHOD V.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ″ | | | | | |
| Apparent distance | 79 | 59 | 54 | | | | | |
| Correction for refraction.. | + 1 | 50 | | | | | | |
| Corrected distance | 80 | 1 | 44 | Sine | 9.9934 | Tangent | 0.7552 | |
| Sun's apparent altitude... | 32 | 59 | | Co-secant | 0.2641 | | | |
| Moon's apparent altitude. | 65 | 35 | | Co-secant | | | 0.0407 | |
| Moon's hor. parallax | | 57 | 20 | Pro. Log. | 0.4969 | | 0.4969 | |
| First arch | | 31 | 41 | Pro. Log. | 0.7544 | | | |
| Second arch | | 9 | 10 | | | Pro. Log. | 1.2928 | |
| Correction for parallax | — 22 | 31 | | | 23′ | 1″ | (XXXV.) | |
| Corrected distance | 80 | 1 | 44 | Parallax in alt. | 23 | 1 | | |
| | 79 | 39 | 13 | | | | | |
| Third correction | | 0 | | | | 0 | | |
| True distance | 79 | 39 | 13 | | | | | |

### *To find the Mean Time at Greenwich.*

| | | | | | |
|---|---|---|---|---|---|
| True distance (Method V.). | 79°39′ 13″ | | | | |
| Distance at 0hrs. by N. A... | 79 35 6 | Intermediate P. Log.... | 2898 | | |
| Difference ..... | 0 4 7 | ..... P. Log.... | 1.6407 | | |
| | h. m. s. | | | | |
| | 0 8 1 | ..... P. Log.... | 1.3509 | | |
| Time of distance by N. A... | 0 0 0 | | | | |
| Mean time at Greenwich ... | 0 8 1 | | | | |

### *To find the Mean Time at Ship, and thence the Longitude.*

| | | | | | |
|---|---|---|---|---|---|
| | ° ′ ″ | | | ° ′ ″ | |
| Sun's apparent altitude..... | 32 59 13 | Sun's declination, June 3 (P. II. N. A.) | | 22 16 5 | N. |
| Sun's correction (XVIII.)... | − 1 20 | Correction for 8m. 1s. (XXI.) ..... | | + 2 | |
| Sun's true altitude..... | 32 57 53 | Sun's declin. at Greenwich mean time | | 22 16 7 | |
| | | | | 90 | |
| | | Sun's polar distance..... | | 67 43 53 | |

| | | | |
|---|---|---|---|
| Sun's true altitude ..... | 32°58′ | | |
| Polar distance..... | 67 44 | .....Co-secant..... | 0.03366 |
| Latitude ..... | 13 29 | .....Secant ..... | 0.01214 |
| Sum .....114 11 | | | |
| Half-sum..... | 57 5½ | .....Co-sine ..... | 9.73504 |
| Remainder ..... | 24 7½ | .....Sine ..... | 9.61144 |
| | h. m. s. | | |
| Apparent time at ship ..... | 3 58 17 | ...Log. ..... | 9.39228 |
| Equation of time ..... | − 2 19 | | |

| | | | m. s. |
|---|---|---|---|
| | | Equation of time, June 3, by N. A... | 2 19.4 |
| Mean time at ship..... | 3 55 58 | Correction for 8m. 1s. (LI.) ..... | 0.0 |
| Mean time at Greenwich ..... | 0 8 1 | | |
| | | Equation at Greenwich mean time.. | 2 19.4 |
| Longitude in time ..... | 3 47 57 = 56° 59′ 15″ East. | | |

## EXAMPLE II.

August 10, 1835, in latitude 47° 10′ 30″ S., and longitude by account 27° 30′ W., when a chronometer, which was 6m. 42s. too slow for Greenwich mean time, shewed 11h. 48m. 28s., the distance of the moon's remote limb from the Star Antares was observed to be 99° 48′ 45″; at the same time the altitude of the moon's lower limb was 26° 11′ 30″, the altitude of the star (being westward of the meridian) 48° 20′; the instruments properly adjusted, and the height of the observer's eye 16 feet: required the true longitude.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | h. m. s. | | | ′ ″ | | ° ″ | |
| Time by chron. ... | 11 48 28 | ☽'s hor. par. at midn.. | | 56 30 | ☽'s semid. at midn. | − 15 24 | |
| Chronometer slow.. | + 6 42 | | | | Augmenta. (VII.) | + 1 | |
| Mean time at Greenw. by chron. | 11 55 10 | | ° | ″ | | − 15 31 | |
| | | Obs. alt. ☽'s L. L... | 26 | 11 30 | ☽'s augm. semid.. | | |
| | ° ′ ″ | Dip of horizon..... | − | 3 50 | Observed distance | 99 48 45 | |
| Star's obs. altitude.. | 48 20 0 | | 26 | 7 40 | Apparent distance | 99 33 14 | |
| Dip of horizon..... | − 3 50 | ☽'s augmen. semid. | + | 15 31 | | | |
| Star's app. altitude. | 48 16 10 | ☽'s app. altitude... | 26 | 23 11 | | | |

## *To find the true Distance.*

### METHOD I.

| | (XXX.) | | (XXX.*) |
|---|---|---|---|
| ☽'s app. alt. 26° 20′, and hor. par. 56′.. | 48′ 7″ | | 60° 13′ 26″ |
| Parts for 3′ altitude | + 9 | | + 2 |
| Ditto for 30″ parallax | + 27 | | + 8 |
| | | Parts for Star's apparent alt. 48° | + 0 |
| Moon's correction | 48 43 | | |
| | | Auxiliary arc | 60 13 36 |

| | ° ′ ″ | | ° ′ ″ |
|---|---|---|---|
| | | Sum of apparent altitudes... | 74 39 21 |
| Star's apparent altitude ... | 48 16 10 | Moon's corr. (XXX.) 48′ 43″ } Star's corr. (XVIII.) 0 51 } | + 47 52 |
| Moon's apparent altitude... | 26 23 11 | | |
| Sum of app. altitudes (A)... | 74 39 21 | Sum of true altitudes..... | 75 27 13 |
| Auxiliary arc .....(B)... | 60 13 36 | | 180 |
| Apparent distance ...(C)... | 99 33 14 | Sum of true zenith distances | 104 32 47 |

| | | | | |
|---|---|---|---|---|
| Sum of A and B ..... | 134 52 57 | ...Versed... | 05459 | parts for seconds 198 |
| Diff. of ditto ..... | 14 25 45 | ...Versed... | 31489 | ... ..... 55 |
| Sum of B and C ..... | 159 46 50 | ...Versed... | 38292 | ..... 86 |
| Diff. of ditto ..... | 39 19 38 | ...Versed... | 26344 | ..... 118 |
| Sum of true zenith dists... | 104 32 47 | ...Versed... | 50943 | ..... 221 |
| | | | 678 | Sum of parts... 678 |
| True distance ..... | 98 48 46 | ...Versed... | 53205 | |

### METHOD II.

| | ° ′ | | ° ′ | | |
|---|---|---|---|---|---|
| Star's apparent altitude... | 48 16 | | 48 16 | | |
| Moon's apparent altitude. | 26 23 | | 26 23 | | |
| | | Apparent distance. | 99 33 | | |
| Sum of apparent altitudes | 74 39 ″ | Sum ..... | 174 12 | Log. difference | 9.997013 |
| Moon's correction 48′ 43″ } Star's correction 0 51 } | + 47 52 | Half-sum ..... | 87 6 | ...Co-sine ..... | 8.704090 |
| | | Difference ..... | 12 27 | ...Co-sine ..... | 9.989665 |
| Sum of true altitudes..... | 75 26 52 | | | | 2)18.690768 |
| Half-sum ..... | 37 43 26 | | | | |
| Arch..... | 12 47 51 | | | ...Sine ..... | 9.345384 |
| Sum ..... | 50 31 17 | | | ...Co-sine ..... | 9.803313 |
| Difference ..... | 24 55 35 | | | ...Co-sine ..... | 9.957536 |
| | | | | | 2)19.760849 |
| | ° ′ ″ | | | | |
| | 49 24 15 | | | ...Sine ..... | 9.880424 |
| | × 2 | | | | |
| | 98 48 30 | | | | |
| Seconds omitted..... | + 14 | | | | |
| True distance..... | 98 48 44 | | | | |

## METHOD III.

| | ° | ′ | | | ° | ′ | | |
|---|---|---|---|---|---|---|---|---|
| Star's apparent altitude | 48 | 16 | | | | | | |
| Moon's apparent altitude | 26 | 23 | | | | | | |
| Sum | 74 | 39 | ....Half | | 37 | 19 | ...Co-tangent... | 0.1179 |
| Difference | 21 | 53 | ....Half | | 10 | 56 | ...Tangent..... | 9.2859 |
| Apparent distance | 99 | 33 | 14″..Half | | 49 | 46½ | ...Co-tangent... | 9.9273 |
| First correction | + | 0 | 44 | | | | | |
| | | | | Arch A. | 12 | 6 | ...Tangent..... | 9.3311 |
| | 99 | 33 | 58 | | | | | |
| Second correction | − | 45 | 12 | Difference | 37 | 40½ | ...Co-tangent... | 0.1123 |
| | | | | Star's apparent altitude | 48 | 16 | ...Co-tangent... | 9.9504 |
| | 98 | 48 | 46 | Star's correction | 0′ | 51″ | ...P. Log. | 2.3259 |
| Third correction | − | | 1 | | | | | |
| | | | | First correction | 0 | 44 | ...P. Log. | 2.3886 |
| True distance | 98 | 48 | 45 | | | | | |
| | | | | Sum | 61°52½′ | | ...Co-tangent... | 9.7280 |
| | | | | Moon's app. altitude... | 26 | 23 | ...Co-tangent... | 0.3045 |
| | | | | Moon's correction | 48′ | 43″ | ...P. Log. | 0.5676 |
| | | | | Second correction | 45 | 12 | ...P. Log. | 0.6001 |

## METHOD IV.

| | ° | ′ | | | | | ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|
| Apparent distance | 99 | 33 | ...Sine | 9.9939 | 9.9939 | Moon's corr.... | − | 48 | 43 |
| Moon's app. altitude... | 26 | 23 | ...Co-sine | 9.9522 | | Second corr.... | − | | 7 |
| Star's app. altitude ... | 48 | 16 | ...Co-sine | 9.8233 | | Fourth corr.... | − | | 17 |
| Sum | 174 | 12 | | | | | − | 49 | 7 |
| | | | | | | App. distance.. | 99 | 33 | 14 |
| Half-sum | 87 | 6. | ..Secant | 1.2959 | 1.2959 | | | | |
| First remainder | 38 | 50 | ...Co-secant | 0.2027 | | | 98 | 44 | 7 |
| Second remainder | 60 | 43 | ...Co-secant | 0.0594 | | Star's corr. ... | + | | 51 |
| Star's correction | 0′ | 51″ | ..P. Log. | 2.3259 | | First corr. | + | 3 | 30 |
| Moon's correction | 48 | 43 | ...P. Log. | 0.5676 | | Third corr. ... | + | | 16 |
| | | | Const. Log.. | 9.6990 | 9.6990 | | | | |
| | | | | | | True distance. | 98 | 48 | 44 |
| First correction | 3 | 30 | ...P. Log. | 1.7113 | P.L. 3.1974 | ...Second corr. | 7″ | | |
| Diff. of corrections | 45 | 13 | | | | | | | |

## METHOD V.

| | ° | ′ | ″ | | | | |
|---|---|---|---|---|---|---|---|
| Apparent distance | 99 | 33 | 14 | | | | |
| Correction for refraction. | + | 2 | 31 | | | | |
| Corrected distance | 99 | 35 | 45 | ...Sine | 9.9939 | ...Tangent.... | 0.7718 |
| Star's apparent altitude.. | 48 | 16 | | ...Co-secant | 0.1271 | | |
| Moon's apparent altitude | 26 | 23 | | ...Co-secant | | | 0.3523 |
| Horizontal parallax | | 56 | 30 | ...Pro. Log. | 0.5032 | | 0.5032 |
| First arch | | 42 | 46 | ...Pro. Log. | 0.6242 | | |
| Second arch | | 4 | 15 | | | Pro. Log. | 1.6273 |
| Correction for parallax... | − | 47 | 1 | | 47′... | 17 | } (XXXV.) |
| Corrected distance | 99 | 35 | 45 | Parallax in alt. | 51 ... | 16 | } |
| | 98 | 48 | 44 | | | | |
| Third correction | − | | 1 | | | 1 | |
| True distance | 98 | 48 | 43 | | | | |

## *To find the Mean Time at Greenwich.*

| | | | |
|---|---|---|---|
| | ° ′ ″ | | |
| True distance (Method V.)..... | 98 48 43 | | |
| Distance at IX. hours by N. A.... | 97 12 48 | Intermediate Pro. Log... | 2682 |
| Difference..... | 1 35 55 | ..... Pro. Log... | 2734 |
| | h. m. s. | | |
| | 2 57 52 | ..... Pro. Log... | 0052 |
| Time of distance by N. A..... | 9 | | |
| Mean time at Greenwich ..... | 11 57 52 | | |

## *To find the Mean Time at Ship, and thence the Longitude, by the Lunar Observation and Chronometer.*

| | | | |
|---|---|---|---|
| | ° ′ ″ | | h. m. s. |
| Star's apparent altitude ..... | 48 16 10 | Star's right ascension, January 1834 | 16 19 14 |
| Refraction (IV. or XVIII.)... | — 51 | Annual variation + 3s.66 × 1½ = | + 5 |
| Star's true altitude ..... | 48 15 19 | Star's right ascension, August 1835, | 16 19 19 |
| | h. m. s. | | ° ′ ″ |
| Sun's right ascen Aug. 10, (P. II. N. A.) ..... | 9 18 9 | Star's declination, January 1834..... | 26 3 18 S. |
| Correc. for 11h. 58m. (XXII.) | + 1 53 | Annual variation + 8″.53 × 1½ = | + 13 |
| | | Star's declination, August 1835..... | 26 3 31 S. |
| Sun's R.A. at Greenw. time... | 9 20 2 | | 90 |
| | | Star's polar distance..... | 63 56 29 |

| | | | |
|---|---|---|---|
| | ° ′ | | |
| Star's true altitude..... | 48 15 | | |
| Star's polar distance ..... | 63 56½ | .....Co-secant..... | 0.04656 |
| Latitude ..... | 47 10½ | .....Secant ..... | 0.16764 |
| Sum ..... | 159 22 | | |
| Half-sum ..... | 79 41 | .....Co-sine ..... | 9.25307 |
| Remainder ..... | 31 26 | .....Sine ..... | 9.71726 |
| | h. m. s. | | |
| Star's dist. from merid. | 3 4 10 W | ....Log..... | 9.18453 |
| Star's right ascension.. | 16 19 19 | | |

| | | | |
|---|---|---|---|
| | | | m. s. |
| Right ascen. of merid.. | 19 23 29 | Equation of time, Aug. 10, by N. A. | 5 9.5 |
| Sun's right ascension... | 9 20 2 | Correction for 11h. 58m. (LL) ..... | — 4.5 |
| Apparent time at ship. | 10 3 27 | Equation at Greenwich time ..... | 5 5.0 |
| Equation of time ..... | + 5 5 | | |
| | | | h. m. s. |
| Mean time at ship..... | 10 8 32 | Aug. 10..... | 10 8 32 |
| Mean time at Greenwich by lunar obs.. | 11 57 52 | Aug. 10. Mean time at Greenw. by chron. | 11 55 10 |
| Longitude in time by lunar observation.. | 1 49 20 = 27° 20′ W. | Longitude in time by chronometer ... | 1 46 38 = 26° 39′ 30″ W. |

## EXAMPLE III.

January 7, 1835, in latitude 24° 32′ N., and longitude by account 35° 15′ W., about 6h. 52m. P. M., the observed angular distance of the moon's remote limb from the centre of the Planet Mars was 72° 42′ 15″; at the same time the altitude of the planet's centre was 27° 12′ (East of the meridian), and the altitude of the moon's lower limb 71° 49′; the height of the observer's eye being 24 feet, and the index error of the sextant with which the distance was taken, + 2′ 15″: required the true longitude of the ship.

| | h. m. |
|---|---|
| Time at ship | 6 52 P.M. |
| Long. in time by ac. | 2 21 W. |
| Greenw. time by ac. | 9 13 |

| | ° ′ ″ |
|---|---|
| Mars' obs. altitude | 27 12 0 |
| Dip of horizon ... | − 4 42 |
| Mars' app. altitude | 27 7 18 |

| | ′ ″ |
|---|---|
| Moon's hor. par. midn. | 54 11 |

| | ° ′ ″ |
|---|---|
| Obs. alt. moon's L. L. | 71 49 0 |
| Dip of horizon ... | − 4 42 |
| | 71 44 18 |
| Moon's aug. semid. | + 15 1 |
| Moon's app. alt. ... | 71 59 19 |

| | ′ ″ |
|---|---|
| Moon's semid., midn... | 14 46 |
| Augmentation (VII). . | + 15 |
| Moon's aug. semid. | − 15 1 |
| Obser. distance / Ind. err. +2′15″ | = 72 44 30 |
| Apparent distance. | 72 29 29 |
| Refrac. for Mars' alt. | 1′ 51″ |
| Mars' parallax in alt. (XLVIII.) | − 12 |
| Mars' correction ... | 1 39 |

### METHOD I.

| | (XXX.) ′ ″ | | (XXX°.) ° ′ ″ |
|---|---|---|---|
| ☽'s app. alt. 71° 50′, and hor. par. 54′ ... | 16 21 | ..... ..... ..... | 60 28 29 |
| Parts for 9′ altitude ..... | + 2 | ..... | + 1 |
| Ditto for 11″ parallax ..... | + 4 | ..... | + 6 |
| Moon's correction ..... | 16 27 | Parts for Mars' app. altitude 27°, and hor. par. 14″ (L.) ..... | + 4 |
| | | Auxiliary arc ..... | 60 28 40 |

| | ° ′ ″ | | ° ′ ″ |
|---|---|---|---|
| Moon's apparent altitude... | 71 59 19 | Sum of apparent altitudes... | 99 6 37 |
| Mars' apparent altitude ... | 27 7 18 | Moon's corr. + 16′ 27″ ... / Mars' corr. − 1 39 ... | + 14 48 |
| Sum of app. altitudes (A)... | 99 6 37 | Sum of true altitudes ..... | 99 21 25 |
| Auxiliary arc ..... (B)... | 60 28 40 | | 180 |
| Apparent distance... (C)... | 72 29 29 | Sum of true zenith dists. ... | 80 38 35 |

| | | | |
|---|---|---|---|
| Sum of A and B ..... | 159 35 17 | ...Versed... 37181 | parts for seconds 28 |
| Diff. of ditto ..... | 38 37 57 | ...Versed... 18661 | ..... 173 |
| Sum of B and C ..... | 132 58 9 | ...Versed... 81573 | ..... 32 |
| Diff. of ditto ..... | 12 0 49 | ...Versed... 21852 | ..... 52 |
| Sum of true zenith dists. ... | 80 38 35 | ...Versed... 37248 | ..... 167 |
| | | 452 | Sum of parts ... 452 |
| True distance ..... | 72 21 36 | ...Versed... 96967 | |

## METHOD II.

| | ° ′ ″ | | ° ′ ″ | | |
|---|---|---|---|---|---|
| Moon's apparent altitude. | 71 59 19 | | 71 59 19 | | |
| Mars' apparent altitude... | 27 7 18 | | 27 7 18 | | |
| | | Apparent dist... | 72 29 29 | | |
| Sum of apparent altitudes | 99 6 37 | | | | |
| Moon's corr. + 16′ 27″ | + 14 48 | Sum ..... | 171 36 6 | Log. difference | 9.993660 |
| Mars' corr. . — 1 39 | | Half ..... | 85 48 3 | Log. co-sine ... | 8.864652 |
| | | Difference ..... | 13 18 34 | Log. co-sine ... | 9.988176 |
| Sum of true altitudes..... | 99 21 25 | | | | |
| | | | | 2) | 18.846488 |
| Half..... | 49 40 42 | | | | |
| Arch..... | 15 22 1 | | | Sine ..... | 9.423244 |
| Sum ..... | 65 2 43 | | | Co-sine ..... | 9.625212 |
| Difference ..... | 34 18 41 | | | Co-sine ..... | 9.916973 |
| | | | | 2) | 19.542185 |
| | ° ′ ″ | | | | |
| | 36 10 48½ | | | Sine ..... | 9.771092 |
| | + 2 | | | | |
| True distance..... | 72 21 37 | | | | |

## METHOD V.

| | ° ′ ″ | | | | |
|---|---|---|---|---|---|
| Apparent distance..... | 72 29 29 | | | | |
| Correction for refraction. | + 1 57 | | | | |
| Corrected distance..... | 72 31 26 | Sine ..... | 9.9795 | Tangent... | 0.5019 |
| Mars' apparent altitude . | 27 7 18 | Co-secant ... | 0.3412 | | |
| Moon's apparent altitude | 71 59 19 | Co-secant..... | | | 0.0218 |
| Moon's hor. parallax..... | 54 11 | Pro. Log. ... | 0.5214 | | 0.5214 |
| First arch ..... | 25 54 | Pro. Log. ... | 0.8421 | | |
| Second arch ..... | 16 13 | | | Pro. Log... | 1.0451 |
| Correction for parallax... | — 9 41 | | 10′ | 0″ | |
| Corrected distance..... | 72 31 26 | Parallax in altitude | 17 | 1 | |
| | 72 21 45 | | | | |
| Third correction ..... | + 1 | | | | 1 |
| | 72 21 46 | | | | |
| Corr. for Mars' parallax . | — 12 | | | | |
| True distance..... | 72 21 34 | | | | |

## *To find the Mean Time at Greenwich.*

| | | | | |
|---|---|---|---|---|
| True distance (Method V.). | 72°21′ 34″ | | | |
| Dist. at IX. hrs. by N. A... | 72 27 40 | Intermediate | P. Log.... | 2941 |
| Difference ..... ..... | 6 6 | ..... | P. Log.... | 1.4699 |
| | h. m. s. | | | |
| | 0 12 1 | ..... | P. Log.... | 1.1758 |
| Time of distance by N.A... | 9 0 0 | | | |
| Mean time at Greenwich... | 9 12 1 | Jan. 7. | | |

## *To find the Mean Time at Ship, and thence the Longitude.*

| | ° | ′ | ″ |
|---|---|---|---|
| Mars' apparent altitude ..... | 27 | 7 | 18 |
| Refraction ..... | — | 1 | 51 |
| | 27 | 5 | 27 |
| Parallax in altitude (XLVIII) ... | | + | 12 |
| Mars' true altitude ..... | 27 | 5 | 39 |

| | h. | m. | s. |
|---|---|---|---|
| Sun's R. A., Jan. 7 (P. II. N. A.) | 19 | 11 | 47 |
| Correction for 9h. 12m. (XXII.)... | + | 1 | 41 |
| Sun's R. A. at Greenwich time ... | 19 | 13 | 28 |

| | h. | m. | s. | | | |
|---|---|---|---|---|---|---|
| Mars' R. A., Jan. 7, | 6 | 43 | 26 | (P.291,N.A.) | | |
| Ditto, Jan. 8, | 6 | 41 | 44 | | | |
| Var. in 24 hours..... | | 1 | 42 | Log. | 1.1498 | |
| Greenwich time..... | 9h. | 12m. | | Log. | 0.4164 | |
| Var. in 9h. 12m..... | — | 0 | 39 | Log. | 1.5662 | |
| Mars' R. A., Jan. 7, | 6 | 43 | 26 | | | |
| Ditto at Greenw. time | 6 | 42 | 47 | | | |

| | ° | ′ | ″ | | | |
|---|---|---|---|---|---|---|
| Mars' dec. Jan. 7, | 27 | 0 | 35 | N. | (P.291,N.A.) | |
| Ditto, Jan. 8, | 27 | 2 | 53 | N. | | |
| Var. in 24 hours... | | 2 | 18 | Log. | 1.0185 | |
| Greenwich time... | 9h. | 12m. | | Log. | 0.4164 | |
| Var. in 9h 12m. | + | 0 | 53 | Log. | 1.4349 | |
| Mars' dec. Jan. 7, | 27 | 0 | 35 | N. | | |
| Ditto at Greenwich time ... | 27 | 1 | 28 | N. | | |
| | 90 | | | | | |
| Mars' polar dist... | 62 | 58 | 32 | | | |

| | ° | | | |
|---|---|---|---|---|
| Mars' true altitude ..... | 27 | 5½ | | |
| Mars' polar distance ..... | 62 | 58½ | .....Co-secant... | 0.05022 |
| Ship's latitude ..... | 24 | 32 | .....Secant ..... | 0.04109 |
| Sum ..... | 114 | 36 | | |
| Half-sum ..... | 57 | 18 | .....Co-sine..... | 9.73259 |
| Remainder ..... | 30 | 12½ | .....Sine ..... | 9.70169 |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| Mars' meridian distance..... | 4 | 43 | 8E. | ..Log..... | 9.52559 |
| Mars' right ascension..... | 6 | 42 | 47 | | |
| Right ascension of meridian. | 1 | 59 | 39 | | |
| | 24 | | | | |
| | 25 | 59 | 39 | | |
| Sun's right ascension ..... | 19 | 13 | 28 | | |
| Apparent time at ship ..... | 6 | 46 | 11 | | |
| Equation of time..... | + | 6 | 37 | | |
| Mean time at ship ..... | 6 | 52 | 48 | Jan. 7. | |
| Mean time at Greenwich ... | 9 | 12 | 1 | Jan. 7. | |
| Longitude in time ..... | 2 | 19 | 13 | = 34° 48′ 15″ W. | |

| | m. | s. |
|---|---|---|
| Eq. of time, Jan. 7, by N. A. | 6 | 27.1 |
| Corr. for 9h. 12m.(LI.) ..... | + | 9.9 |
| Eq. at Greenwich time..... | 6 | 37.0 |

## EXAMPLE IV.

September 18, 1835 (civil time), in latitude 47° 45′ N., and longitude by account 129° 15′ W., the following sets of altitudes and distances were observed at about 11h. 10m. A. M. ship-time, in order to determine the true longitude; the corresponding times being taken by a chronometer, which was at the time of observation 32m. 48s. *fast* for mean time at Greenwich, and was gaining 14s. per day; the height of the observer's eye being 20 feet, and the errors of the instruments previously ascertained.

| Times by chron. | Obs. alts. ⊙'s L. L. | Obs. alts. ☽'s U. L. | Obs. distances. |
|---|---|---|---|
| h. m. s. | ° ′ ″ | ° ′ ″ | ° ′ ″ |
| 8 15 45 | 44 43 0 | 12 29 15 | 104 38 10 |
| 17 10 | 49 15 | 12 10 0 | 37 25 |
| 18 17 | 54 30 | 11 55 30 | 36 40 |
| 19 23 | 56 15 | 11 42 0 | 35 50 |
| 20 10 | 59 0 | 11 31 0 | 35 5 |
| 5) 90 45 | 262 0 | 59 47 45 | 183 10 |
| Means ..... 8 18 9 | 44 52 24 | 11 57 33 | 104 36 38 |
| Chronometer fast.. — 32 48 | + 1 30 | — 1 10 | — 0 15 Ind. errs. |
| Mean time at Greenw. by chron. 7 45 21 Sept. 13. | 44 53 54 | 11 56 23 | 104 36 23 |

| | | | |
|---|---|---|---|
| Moon's hor. par. at noon, Sept. 13... | ′ ″ 54 10 | Moon's semidiam. at noon, Sept. 13.. | ′ ″ 14 46 |
| Ditto at midn. Sept. 13... | 54 12 | Ditto at midn. Sept. 13.. | 14 46 |
| Difference in 12 hours ..... | 2 | Difference in 12 hours ..... | 0 |
| 12h. : 2″ :: 8h. : | + 1″ | 12h. : 0″ :: 8h. : | 0 |
| Moon's hor. par. at noon, Sept. 13 ... | 54 10 | Moon's semidiam. at noon, Sept. 13... | 14 46 |
| Ditto at Greenw. mean time | 54 11 | Ditto at Greenw. mean time | 14 46 |
| | | Moon's augmentation | + 3 |

| | | | | | |
|---|---|---|---|---|---|
| | ° ′ ″ | | | ° ′ ″ | |
| Obs. alt. sun's L. L. | 44 53 54 | Obs. alt. moon's U. L. | | 11 56 23 | Moon's aug. semid. + 14 49 |
| Dip of horizon ... | — 4 17 | Dip of horizon..... | | — 4 17 | Sun's semidiameter + 15 56 |
| | 44 49 37 | | | 11 52 6 | Observed distance 104° 36 23 |
| Sun's semidiam... | + 15 56 | Moon's aug. semid. | | — 14 49 | Apparent distance 105 7 8 |
| Sun's app. alt..... | 45 5 33 | Moon's app. alt. ... | | 11 37 17 | |

### *To find the true Distance.*

#### METHOD I.

| | (XXX.) | | (XXX.°) |
|---|---|---|---|
| ☽'s app. alt. 11° 30′ and hor. par. 54′... | 48′ 20″ | ..... | 60° 5′ 19″ |
| Parts for 7′ altitude ..... | + 2 | ..... | + 4 |
| Ditto for 11″ parallax ..... | + 11 | ..... | + 1 |
| | | Parts for sun's app. alt. 45° ..... | + 4 |
| Moon's correction..... | 48 33 | | |
| | | Auxiliary arc ..... | 60 5 28 |

| | ° | ′ | ″ | | | | | ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|
| Moon's apparent altitude . | 11 | 37 | 17 | Sum of apparent altitudes..... | | | | 56 | 42 | 50 |
| Sun's apparent altitude ... | 45 | 5 | 33 | Moon's corr. (XXX) | + | 48′ | 33″ | + | 47 | 42 |
| | | | | Sun's corr. (XVIII.) | − | 51 | | | | |
| Sum of app. altitudes (A). | 56 | 42 | 50 | Sum of true altitudes..... | | | | 57 | 30 | 32 |
| Auxiliary arc ..... (B). | 60 | 5 | 28 | | | | | 180 | | |
| Apparent distance ... (C). | 105 | 7 | 8 | Sum of true zenith distances..... | | | | 122 | 29 | 28 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sum of A and B ..... | 116 | 48 | 18 | Versed..... | 50878 | parts for seconds 78 |
| Diff. of ditto ..... | 3 | 22 | 38 | Versed..... | 01726 | ..... 12 |
| Sum of B and C ..... | 165 | 12 | 36 | Versed..... | 66823 | ..... 44 |
| Diff. of ditto ..... | 45 | 1 | 40 | Versed..... | 93099 | ..... 139 |
| Sum of true zenith dists.... | 122 | 29 | 28 | Versed..... | 37054 | ..... 114 |
| | | | | | 387 | Sum of parts ... 387 |
| True distance ..... | 104 | 28 | 32 | Versed..... | 49967 | |

## METHOD V.

| | ° | ′ | ″ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Apparent distance..... | 105 | 7 | 8 | | | | | | |
| Correction for refraction. | + | 4 | 12 | | | | | | |
| Corrected distance..... | 105 | 11 | 20 | Sine ..... | 9.9846 | Tangent.... | 0.5664 | | |
| Sun's apparent altitude.. | 45 | 5 | 33 | Co-secant ... | 0.1498 | | | | |
| Moon's apparent altitude | 11 | 37 | 17 | Co-secant..... | | | 0.6960 | | |
| Moon's hor. parallax..... | | 54 | 11 | Pro. Log. ... | 0.5214 | | 0.5214 | | |
| First arch ..... | | 39 | 46 | Pro. Log. ... | 0.6558 | | | | |
| Second arch ..... | | 2 | 58 | | | Pro. Log. | 1.7838 | | |
| Correction for parallax... | − | 42 | 44 | | 43′ | 16″ | (XXXV.) | | |
| Corrected distance ..... | 105 | 11 | 20 | Parallax in alt. | 53 | 13 | | | |
| | 104 | 28 | 36 | | | | | | |
| Third correction ..... | − | | 3 | | | 3 | | | |
| True distance ..... | 104 | 28 | 33 | | | | | | |
| Distance at VI. hours ... | 105 | 15 | 46 | Intermediate Pro. Log. | | | 3461 | | |
| Difference ..... | | 47 | 13 | | | Pro. Log. | 5812 | | |
| | h. | m. | s. | | | | | | |
| | 1 | 44 | 45 | | | Pro. Log. | 2351 | | |
| Time of distance from N.A. | 6 | | | | | | | | |
| Mean time at Greenwich. | 7 | 44 | 45 | Sept. 13 | | | | | |
| | 24 | | | | | | | | |
| Ditto..... | 31 | 44 | 45 | past noon, Sept. 12 | | | | | |

The sun being too near the meridian at the time of taking the distances, to infer the time from its altitude, the following observations were made at about 4h. 5m. P. M. ship-time, in order to determine the error of the chronometer at the meridian of the ship; the latitude being then 47° 8′ N., the

longitude by account 128° 32′ W., the height of the observer's eye 20 feet, and the error of the sextant 1′ 10″ to subtract: required the longitude of the ship by chronometer and lunar observation when the altitudes were taken.

| Times by Chro. | Obs. Alts. ☉'s L. L. | | | | | |
|---|---|---|---|---|---|---|
| h. m. s. | ° ′ ″ | | | | ° ′ ″ | |
| 13 11 15 | 21 42 20 | Sun's declin. Sept. 13, (P.II.N.A.)..... | 3 59 8N. | | | |
| 12 30 | 21 26 20 | | | | | |
| 13 26 | 21 15 50 | Correc. for 12h. 0m. (XXI.)..... | — 11 37 | | | |
| 15 0 | 20 57 5 | | | | | |
| 16 19 | 20 44 20 | Correc. for 0h. 41m.... | — 41 | | | |
| 5) 68 30 | 106 5 55 | Sun's declination at Greenwich time ... | 3 46 50N. | | | |
| Mean of times by chronometer. 13 13 42 | 21 13 11 | | 90 | | | |
| Chronometer gained in 5 hours — 3 | — 1 10 | Index err. | | | | |
| | | Sun's polar distance ... | 86 13 10 | | | |
| Mean time shewn by chron. when ☉'s alt. was observed 13 13 39 | 21 12 1 | | | | | |
| Chron. fast when dist. was obs. — 32 48 | — 4 17 | Dip of hor. | | | | |
| | | | m. s. | | | |
| Mean time at Greenw. by chron. 12 40 51 | 21 7 44 | Equation of time Sept. 13, by N. A. ..... | 3 58.9 | | | |
| Correction Table XVIII. | — 2 18 | Corr. for 12h. 41m. (LI)... | + 11.2 | | | |
| | 21 5 26 | Equation at Greenw. time | 4 10.1 | | | |
| Sun's semidiameter ..... | + 15 56 | | | | | |
| Sun's true altitude..... | 21 21 22 | | | | | |

| | ° ′ | | |
|---|---|---|---|
| Sun's polar distance..... | 86 13 | .....Co-secant | 0.00095 |
| Ship's latitude ..... | 47 8 | .....Secant ... | 0.16730 |
| True altitude ..... | 21 21½ | | |
| Sum ..... | 154 42½ | | |
| Half-sum ..... | 77 21 | ...Co-sine... | 9.34043 |
| Remainder ..... | 55 59½ | ...Sine ..... | 9.91853 |

| | h. m. s. | | | h. m. s. | ° ′ ″ |
|---|---|---|---|---|---|
| Apparent time at ship ..... | 4 9 7 | .....Log. ..... | 9.42721 | | |
| Equation of time..... | — 4 10 | | | | |
| Mean time at ship ..... | 4 4 57 | Sept. 13 ..... | 4 4 57 | | |
| Mean time shewn by chron. when the above alt. was observed..... | 13 13 39 | Mean time at Greenw. by chron. | 12 40 51 | | |
| Chron. *fast* for mean time at ship... | 9 8 42 | Long. in time by chr. | 8 35 54 | = | 128 58 30W. |
| Time by chro. when dist. was taken | 32 18 9 | past noon, Sept. 12. | | | |
| Mean time of obs. distance at ship. | 23 9 27 | ditto, | Sept. 12. | | |
| Mean time at Greenwich when the distance was taken ..... | 31 44 45 | ditto, | Sept. 12. | | |
| Longitude in time where the above error of chronometer was found | 8 35 18 | = 128° 49′ 30″ W. | | | |

NOTE. The above being the longitudes deduced from the chronometer and lunar observation, at 4h. 4m. 57s. mean time at the ship, September 13, that is when the altitudes for time were taken, they may be reduced to noon, or any other time of the day, by the log.

Thus, suppose it were required to find the longitude of the ship when the distances were observed. By comparing the longitudes by account at both observations, it appears that the ship has made 43 miles of longitude to the East; which, being added to 128° 49′ 30″ W., the longitude by the lunar observation, when the altitudes were observed for time, gives the longitude 129° 32′ 30″ W. when the distances were taken; the longitude by the chronometer at that time being 129° 41′ 30″ W.

## EXAMPLE V.

March 16, 1835, in latitude 36° 7′ S., and longitude by account 32° East, the following altitudes of the sun's lower limb were observed at about 4h. 50m. P. M. ship-time, with the corresponding times taken from a chronometer that was 5m. 48s. fast for Greenwich mean time, when the altitudes were observed, and was gaining daily 2.5s.; the height of the observer's eye being 18 feet, and the error of the instrument 0′ 30″ to be subtracted: required the mean time, and error of the chronometer for the meridian of the ship, likewise the longitude of the ship by the chronometer.

| Times by Chro. h. m. s. | Alts. of ⊙'s L. L. ° ′ ″ |
|---|---|
| 2 46 30 | 17 35 30 |
| 47 56 | 17 17 30 |
| 49 5 | 17 4 10 |
| 50 15 | 16 49 50 |
| 51 9 | 16 39 25 |
| 5) 244 55 | 5) 85 26 25 |
| Mean of times by chro. 2 48 59 | Mean ..... 17 5 17 |
| Chronometer fast ... — 5 48 | Index error ... — 30 |
| Mean time at Green. by chronometer ... 2 43 11 | Obs. alt. of L.L. 17 4 47 |

| | ° ′ ″ | |
|---|---|---|
| Obs.alt.of sun's L.L. | 17 4 47 | |
| Dip of horizon ..... | — 4 4 | |
| | 17 0 43 | |
| Corr.from T.XVIII. | — 2 56 | |
| | 16 57 47 | |
| Sun's semidiameter | + 16 5 | |
| Sun's true altitude. | 17 13 52 | |

| | ° ′ ″ | | m. s. |
|---|---|---|---|
| Sun's dec. (P. II. N. A.)..... | 1 54 28 S. | March 16. | Eq. of time by N. A. 8 58.1 |
| Corr. for 2h. 43m. (XXI)..... | — 2 38 | | Corr. for 2h. 43. (LI). — 2.0 |
| Sun's dec. at Greenwich time. | 1 51 50 S. | | Eq. at Greenw. time. 8 56.1 |
| | 90 | | |
| Polar distance..... | 88 8 | ...Co-secant... | 0.00023 |
| Ship's latitude..... | 36 7 | ...Secant ..... | 0.09269 |
| True altitude ..... | 17 14 | | |
| Sum ..... | 141 29 | | |
| Half-sum ..... | 70 44½ | ...Co-sine ... | 9.51828 |
| Remainder..... | 53 30¼ | ...Sine..... | 9.90523 |
| | h. m. s. | | |
| Apparent time at ship ..... | 4 39 43 | ...Log..... | 9.51643 |
| Equation of time ..... | + 8 56 | | |
| Mean time at ship ..... | 4 48 39 | March 16 ..... | h. m. s. 4 48 39 |
| Mean of times by chronom.... | 2 48 59 | Mean time at Gr. by chro. | 2 43 11 |
| Chro. *slow* for mean time at ship | 1 59 40 | Long. in time by chron.. | 2 5 28 = 31° 22′ E. |

In the evening the following observations were made of the moon and the Star Regulus (or $\alpha$ Leonis:) required from thence the longitude of the ship when the altitudes were taken, to ascertain the error of the chronometer for ship-time.

| Times by Chron. | Alts. of Moon's L.L. | Alts. of ☌ Regulus. | Dist. ☽'s R.L. from ☌ |
|---|---|---|---|
| h. m. s. | ° ′ ″ | ° ′ ″ | ° ′ ″ |
| 7 32 30 | 25 56 0 | 38 55 0 | 55 3 20 |
| 34 14 | 26 19 0 | 39 2 0 | 4 10 |
| 35 50 | 26 44 0 | 39 10 0 | 5 5 |
| 37 17 | 27 1 0 | 39 14 0 | 5 40 |
| 39 19 | 27 35 0 | 39 23 0 | 6 35 |
| 5) 179 10 | 133 35 0 | 195 44 0 | 24 50 |
| Mean of times by chron. 7 35 50 | 26 43 0 | 39 8 48 | 55 4 58 |
| Chro. gained in interval — 0.5 | + 2 0 | — 3 20 | — 30 Ind. errs. |
| 7 35 49.5 | 26 45 0 | 39 5 28 | 55 4 28 |

Chron *slow* for merid. of ship where time-alts. were observed..... 1 59 40

Mean time at that mer. when dist. was obs... 9 35 29.5

| | h. m. s. |
|---|---|
| Mean of times by chronometer. | 7 35 50 |
| Chron. *fast* for Greenw. time ... | — 5 48 |
| Chron. gained in 5 hours..... | — 0.5 |
| Mean time at Greenw. by chron. | 7 30 1.5 |

| | ′ ″ |
|---|---|
| Moon's horizontal parallax at noon... | 60 37 |
| Ditto at midn... | 60 36 |
| Difference in 12 hours ..... | 1 |
| 12h. : 1″ :: 7½h. : 1″ | |
| Moon's horizontal parallax at noon ... | 60 37 |
| Ditto at Greenwich mean time..... | 60 36 |

| | ° ′ ″ |
|---|---|
| Observed altitude moon's L. L. ... | 26 45 0 |
| Dip of horizon ..... | — 4 4 |
| | 26 40 56 |
| Moon's augmented semidiameter.. | + 16 38 |
| Moon's apparent altitude..... | 26 57 34 |

| | ′ ″ |
|---|---|
| Moon's semidiameter at noon ..... | 16 31 |
| Ditto at midnight ... | 16 31 |
| Difference in 12 hours ..... | 0 |
| 12h. : 0″ :: 7½ : 0″ | |
| Moon's semidiameter at noon ..... | 16 31 |
| Ditto at Greenwich mean time..... | 16 31 |
| Moon's augmentation (VII)..... | + 7 |
| Moon's augmented semidiameter . | — 16 38 |
| Obs. dist. of moon's remote limb... | 55° 4 28 |
| Apparent distance ..... | 54 47 50 |

| | ° ′ ″ |
|---|---|
| Star's observed altitude ..... | 39 5 28 |
| Dip of horizon ..... | — 4 4 |
| Star's apparent altitude ..... | 39 1 24 |

## *To find the true Distance.*

### METHOD I.

| | (XXX.) | (XXX″.) |
|---|---|---|
| ☽'s app. alt. 26° 50′, and hor. par. 60′.. | 51′ 30″ | 60° 14′ 45″ |
| Parts for 8′ altitude ..... | + 7 | + 4 |
| Ditto for 36″ parallax..... | + 32 | + 9 |
| Moon's correction ..... | 52 9 | |
| Parts for star's apparent alt. 39° | | + 0 |
| Auxiliary arc ..... | | 60 14 58 |

| | ° | ′ | ″ |
|---|---|---|---|
| Moon's apparent altitude | 26 | 57 | 34 |
| Star's apparent altitude | 39 | 1 | 24 |
| Sum of app. altitudes (A) | 65 | 58 | 58 |
| Auxiliary arc (B) | 60 | 14 | 58 |
| Apparent distance (C) | 54 | 47 | 50 |

| | ° | ′ | ″ |
|---|---|---|---|
| Sum of apparent altitudes | 65 | 58 | 58 |
| Moon's corr. (XXX) + 52′ 9″ | | | |
| Star's corr. (XVIII) − 1 10 | + 50 | 59 | |
| Sum of true altitudes | 66 | 49 | 57 |
| | 180 | | |
| Sum of true zenith distances | 113 | 10 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sum of A and B | 126 13 56 | Versed | 90840 | parts for seconds | 219 |
| Diff. of ditto | 5 44 0 | Versed | 05002 | | 0 |
| Sum of B and C | 115 2 48 | Versed | 23146 | | 210 |
| Diff. of ditto | 5 27 8 | Versed | 04520 | | 3 |
| Sum of true zenith dists. | 113 10 3 | Versed | 93407 | | 31 |
| | | | 445 | Sum of parts | 445 |

| | ° | ′ | ″ | | |
|---|---|---|---|---|---|
| True distance | 54 | 21 | 49 | Versed | 17360 |

## METHOD V.

| | | | | | | |
|---|---|---|---|---|---|---|
| Apparent distance | 54 | 47 | 50 | | | |
| Correction for refraction | + | 1 | 7 | | | |
| Corrected distance | 54 | 48 | 57 | Sine 9.9124 | Tangent | 0.1518 |
| Star's apparent altitude | 39 | 1 | 24 | Co-secant 0.2010 | | |
| Moon's apparent altitude | 26 | 57 | 34 | Co-secant | | 0.3436 |
| Moon's hor. parallax | | 60 | 36 | Pro. Log. 0.4728 | | 0.4728 |
| First arch | | 46 | 41 | Pro. Log. 0.5862 | | |
| Second arch | | 19 | 22 | | Pro. Log. | 0.9682 |
| Correction for parallax | − | 27 | 19 | 27′ | 4″ | (XXXV.) |
| Corrected distance | 54 | 48 | 57 | Parallax in altitude 54 | 18 | |
| | 54 | 21 | 38 | | | |
| Third correction | | + | 14 | | 14 | |
| True distance | 54 | 21 | 52 | | | |
| Distance at VI h. by N. A. | 53 | 26 | 58 | Intermediate Pro. Log. | 2080 | |
| Difference | | 54 | 54 | Pro. Log. | 5157 | |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| | 1 | 28 | 38 | Pro. Log. | 3077 |
| Time of distance from N. A. | 6 | | | | |

| | | | | |
|---|---|---|---|---|
| Mean time at Greenwich | 7 | 28 | 38 | March 16. |
| Ditto at ship by chronometer when the distances were observed | 9 | 35 | 29.5 | March 16. |
| Long. in time at the place where the alts. were obs. to find the error of the chron. | 2 | 6 | 51.5 = 31°42′ 52″ | E. |

When the time under the meridian of the ship cannot be found from altitudes taken with the distances, as is the case in the fourth and fifth Examples, the observer may, instead of finding the error of the watch or chronometer by altitudes taken before or after the distances, note the times

by a chronometer at both observations, by which he will obtain the interval of time between those observations; this applied to the mean time at the ship when altitudes were observed for time, will shew the time under that meridian when the distances were taken; to which the longitude made during the interval, reduced to time, being applied, by adding or subtracting it, according as the ship's place, when the distances were observed, is east or west of its place when the altitudes for time were taken, the result will be the time at the ship corresponding to the place where the distances were observed: this compared with the time at Greenwich, will shew the ship's longitude at the time of taking the distances.

Suppose, for instance, that in the fifth Example, page 284, when altitudes of the sun were taken, about 4h. 50m. P. M., ship-time, the mean of the times shewn by a chronometer, gaining 2. 5 seconds per day, was 2h. 48m. 59s., and the time by the same chronometer, when the distances were observed, 7h. 35m. 50s., the ship having, between the observations, made 48 miles of longitude to the eastward; we may proceed, as follows, to find the time at ship when the distances were taken, and thence the longitude at that time.

| | h. | m. | s. | | | |
|---|---|---|---|---|---|---|
| Mean time by chronometer when the sun's altitudes were observed | 2 | 48 | 59 | | | |
| Mean time by chronometer when the distances were observed | 7 | 35 | 50 | | | |
| Interval of time by chronometer | 4 | 46 | 51 | | | |
| Proportional part of rate or daily gain of chronometer during the above interval | | | — 0.5 | | | |
| Interval corrected for rate of chronometer | 4 | 46 | 50.5 | | | |
| Mean time at ship when sun's altitudes were observed | 4 | 48 | 39 | | | |
| Mean time at the above meridian when the distances were observed. | 9 | 35 | 29.5 | | | |
| Change of longitude (in time) during the interval 48′ E. | + | 3 | 12 | | | |
| Mean time at ship, corresponding to the place where the distances were observed | 9 | 38 | 41.5 | | | |
| Mean time at Greenwich when the distances were observed | 7 | 28 | 38 | | | |
| | | | | ° | ′ | ″ |
| Longitude of ship when the distances were observed | 2 | 10 | 3.5 | = 32 | 30 | 52 E. |

In the preceding Examples we have supposed altitudes to be taken at the same time with the distances; but circumstances may arise, such as an undefined horizon, or want of assistants, which may prevent the altitudes of one or both the objects being observed: in these cases it will be necessary to compute the altitudes corresponding to the distances.

For this purpose, take a set of altitudes when the object is at a proper distance from the meridian, either before or after the distances are observed, noting the times by a chronometer, or steady going watch, from which compute the apparent and mean time at ship; note also the times, by the same chronometer or watch, when the distances are observed; then, by means of the elapsed time, and the change of longitude during that interval, find the mean time at the place where the distances were observed, as explained above; corresponding to which, compute the altitudes by the following

RULES. 1. Find the least meridian distance of the given object, which, if it be the sun, is the apparent time from the nearest noon; but if the object be the moon, a planet, or star, then add the sun's right ascension to the apparent time: their sum (deducting 24 hours, if it exceed that time) will be the right ascension of the meridian; the difference between which and the right ascension of the object, in time, will be its meridian distance; but should the remainder exceed 12 hours, subtract it from 24 hours, to give the least meridian distance.

2. Add together the log. rising of the meridian distance (XXIX.), the log. co-sine of the latitude (XXV.), and the log. co-sine of the declination.

3. Find the natural number corresponding to the sum of these three logarithms (XXIV.), rejecting the tens from the index, and add it to the natural versed sine (XXXVI.) of the difference of the declination and latitude, when they are of the same name—or of their sum, when of contrary names; the sum will be the natural versed sine of the true zenith distance, which subtracted from 90°, will give the true altitude*.

4. If the object be the sun or a star, their correction from Table XVIII. added to the true altitude, will give the apparent altitude; if it be a planet, the refraction (IV.) is to be added, and the parallax in altitude (XLVIII.) is to be subtracted from the true altitude; but should the moon's apparent altitude be required, the correction taken from Table XXX., with the true altitude and horizontal parallax, is to be subtracted from the true altitude.†

NOTE. The right ascension and declination of the sun, moon, or a planet, and the moon's horizontal parallax, are to be taken from the Nautical Almanac, and reduced to Greenwich time of observation. The right ascension and declination of a star are to be taken from Table XIII., and reduced to the given year and month.

Here follow two Examples, in which the apparent altitudes are found by the above Rules.

## EXAMPLE VI.

April 4, 1835 (civil time), in latitude 15° 10′ N., and longitude by account 62° 36′ E., about 8h. 10m. A. M, ship-time, the observed altitude of the sun's lower limb was 31° 47′ 10″; a chronometer, whose daily rate was 16 seconds losing, at the same time shewing 4h. 2m. 46s., the height of the observer's eye being 18 feet, and the error of the sextant + 2′ 30″.

On the same morning, when the above chronometer shewed 6h. 31m. 58s., the distance between the sun and moon was observed to be 66° 20′ 20″, the ship having, since the first observation, made 12 miles of latitude to the South, and 36 miles of longitude to the West, the height of the eye and index error as before: required the longitude of the ship at the time the distance was observed.

* In this operation the log. co-sines are to be taken out to five places of decimal figures only, and the natural versed sines to the *first five decimal figures* in the Table.

† The result of the above will be the *approximate* apparent altitude; and if greater accuracy be required, the moon's correction should be again taken out with the approximate apparent altitude, and applied to the true altitude, instead of the former correction.

| | h. | m. | | |
|---|---|---|---|---|
| Apparent time at ship..... | 20 | 10 | April | 3. |
| Longitude by account in time | 4 | 10 | E: | |
| App. time at Greenw. by acc. | 16 | 0 | | |
| Equation of time ..... | + | 3 | | |
| Mean time at Greenw. by acc. | 16 | 3 | April | 3. |

| | h. | m. | s. |
|---|---|---|---|
| Time by chron. when the sun's altitude was observed..... | 4 | 2 | 46 |
| Ditto when distance was observed . | 6 | 31 | 58 |
| Interval of time between the obs.... | 2 | 29 | 12 |
| Pro. part of rate during the interval | + | | 2 |
| Interval corrected for rate..... | 2 | 29 | 14 |

| | ° | ′ | ″ |
|---|---|---|---|
| Observed alt. of sun's lower limb.. | 31 | 47 | 10 |
| Index error to be added ..... | + | 2 | 30 |
| | 31 | 49 | 40 |
| Corr. from Table IX. + 10′.4=... | + | 10 | 24 |
| Sun's true altitude ..... | 32 | 0 | 4 |

| | ° | ′ | ″ |
|---|---|---|---|
| Sun's declin. April 3, (P. II. N.A.) | 5 | 8 | 41N. |
| Cor. for Gr. time 12h. 0m. (XXI.) | + | 11 | 31 |
| Ditto ditto 4h. 3m..... | + | 3 | 50 |
| Sun's declin. at Greenwich time.. | 5 | 24 | 2N. |
| | | 90 | |
| Sun's polar distance ..... | 84 | 35 | 58 |

| | ° | ′ | | |
|---|---|---|---|---|
| Sun's polar distance..... | 84 | 36 | Co-secant... | 0.00193 |
| Ship's latitude ..... | 15 | 10 | Secant ..... | 0.01540 |
| Sun's true altitude ..... | 32 | 0 | | |
| Sum .....| 131 | 46 | | |
| Half-sum ..... | 65 | 53 | Co-sine..... | 9.61129 |
| Remainder ..... | 33 | 53 | Sine ..... | 9.74625 |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| Apparent time from noon ..... | 3 | 53 | 6 | Log..... | 9.37487 |
| | 24 | | | | |
| Apparent time at place of observing the sun's altitude ..... | 20 | 6 | 54 | April | 3. |
| Equation of time ..... | + | 3 | 18 | | |
| Mean time at place, as above ..... | 20 | 10 | 12 | | |
| Interval between the observations ..... | 2 | 29 | 14 | | |
| Mean time at above place when the distances were observed ..... | 22 | 39 | 26 | | |
| Change of longitude 36′ W. in time.... | − | 2 | 24 | | |
| Mean time at place of observing the dist. | 22 | 37 | 2 | April | 3. |
| | 24 | | | | |
| Ditto before noon..... | 1 | 22 | 58 | April | 4. |

| | m. | s. |
|---|---|---|
| Equation by N. A. April 3 ..... | 3 | 30.1 |
| Correction for 12h. 0m. (LI.) ... | − | 9.0 |
| Ditto 4h. 3m. ..... | − | 3.0 |
| Equation at Greenwich time ... | 3 | 18.1 |

## *To find the Sun's apparent Altitude when the Distance was observed.*

| | ° | ′ | | ° | ′ | |
|---|---|---|---|---|---|---|
| Latitude when the sun's alt. was obs. | 15 | 10N. | Long. by acc. when ⊙'s alt. was obs. | 62 | 36 | E. |
| Diff. of lat. made during the interval | − | 12 S. | Diff. of long. during the interval... | − | 36 | W. |
| Latitude when the dist. was observed | 14 | 58N. | Long. by acc. when dist. was obs... | 62 | 0 | E. |

| | h. | m. | s. | | ° | ′ | ″ | |
|---|---|---|---|---|---|---|---|---|
| Mean time at ship when distance was observed ..... | 22 | 37 | 2 | Sun's declin. April 3, (P. II. N.A.) | 5 | 8 | 41 | N. |
| Long. of the ship in time (XIX.) | 4 | 8 | 0 E. | Cor. for Gr. time 12h. 0m. (XXI.) | + | 11 | 31 | |
| | | | | Ditto 6h. 29m..... | + | 6 | 14 | |
| Mean time at Greenwich ..... | 18 | 29 | 2 | Sun's declin. at Greenwich time . | 5 | 26 | 26 | N. |

| | h. m. s. | | |
|---|---|---|---|
| Time from noon ..... | 1 22 58 | .....Log. rising... | 3.81167 |
| Ship's latitude..... | 14°58′ N. | .....Co-sine ..... | 9.98501 |
| Sun's declination ..... | 5 26½ N. | .....Co-sine ..... | 9.99804 |
| | Nat. number... 6233 | ...Log..... | 3.79472 |
| Difference ..... | 9 31½ | ...Versed .....01379 | |
| True zenith distance ... | 22 30 | ...Versed .....07612 | |
| | 90 | | |
| Sun's true altitude..... | 67 30 | | |
| Refraction ..... | — 0 | | |
| Sun's apparent altitude | 67 30 | | |

## *To find the Moon's apparent Altitude when the Distance was observed.*

| | h. m. s. | | ° ′ ″ | |
|---|---|---|---|---|
| Moon's R. A. at 18h. Apr. 3, | 5 14 42 (P.V.N.A.) | Moon's dec. at 18h. Apr. 3, | 23 56 37 N. | P. V. / N. A. |
| Ditto at 19h..... | 5 16 51 | Ditto, at 19h. ..... | 24 1 32 N. | |
| Variation in 1 hour ..... | 2 9 Log.1·4457 | Variation in 1 hour ..... | 4 55 Log.1·0865 | |
| Greenwich time after 18h... | 29 2 Log.0·3153 | Greenwich time after 18h... | 29m. 2s. Log.0·3153 | |
| | h. m. s. | | ° ′ ″ | |
| Variation in 29m. 2s. .... | + 1 2 Log.1·7610 | Variation in 29m. 2s. .... | + 2 23 Log.1·4018 | |
| Moon's R. A. at 18h. Apr. 3, | 5 14 42 | Moon's dec. at 18h. Apr. 3, | 23 56 37 N. | |
| Ditto at Greenwich time .. | 5 15 44 | Ditto at Greenwich time .. | 23 59 0 N. | |

| | h. m. s. | | |
|---|---|---|---|
| Mean time at ship ..... | 22 37 2 | Moon's hor. parallax at Greenwich time .... | 54′ 34″ |
| Sun's right ascension ..... | 0 50 41 | | h. m. s. |
| | | Sun's right ascen. April 3 (P. II. N. A.).... | 0 47 53 |
| R. A. of the meridian..... | 23 27 43 | Corr. for Greenwich time, 12h. 0m. (XXII). | + 1 49 |
| Moon's R. A. at Greenwich time | 5 15 44 | Ditto, 6h. 29m. ..... | + 0 59 |
| Moon's meridian distance ..... | 18 11 59 | Sun's right ascension at Greenwich time.... | 0 50 41 |
| | 24 | | |
| Moon's least meridian distance . | 5 48 1 | .....Log. rising .. | 4·97668 |
| Ship's latitude..... | 14°58′ N. | .....Co-sine .... | 9·98501 |
| Moon's declination ..... | 23 59 N. | .....Co-sine .... | 9·96079 |
| | Nat. number .... 83653 | .....Log..... | 4·92248 |
| Difference ..... | 9 1 | ..Versed ..... 01236 | |
| True zenith distance ..... | 81 18½ | ..Versed ..... 84889 | |
| | 90 | | |
| Moon's true altitude ..... | 8 41½ | | |
| Corr. from Table XXX. ..... | — 48 | | |
| Moon's apparent altitude ..... | 7 53½ | | |

*To find the True Distance* (BY METHOD V.), *and thence the Longitude.*

| | ° | ′ | ″ | | | | | |
|---|---|---|---|---|---|---|---|---|
| Observed dist. by sextant | 66 | 20 | 20 | | | | | |
| Index error ..... | + | 2 | 30 | | | | | |
| Dist. corr. for Index error | 66 | 22 | 50 | | | | | |
| Sun's semidiameter ..... | + | 16 | 0 | | | | | |
| Moon's semidiameter ... | + | 14 | 52 | | | | | |
| Moon's augmentation ... | + | | 2 | | | | | |
| Apparent distance..... | 66 | 53 | 44 | | | | | |
| Correction for refraction. | + | 6 | 0 | | | | | |
| Corrected distance..... | 66 | 59 | 44 | ...Sine ..... | 9.9640 | ...Tangent... | 0.3721 | |
| Sun's apparent altitude . | 67 | 30 | 00 | ...Co-secant ... | 0.0344 | | | |
| Moon's apparent altitude | 7 | 53 | 30 | ...Co-secant..... | | | 0.8623 | |
| Moon's hor. parallax..... | | 54 | 34 | ...Pro. Log. ... | 0.5183 | | 0.5183 | |
| First arch ..... | | 54 | 47 | ...Pro. Log. ... | 0.5167 | | | |
| Second arch ..... | | 3 | 11 | | | Pro. Log... | 1.7527 | |
| Correction for parallax... | — | 51 | 36 | | | 52′...10″ | } (XXXV.) | |
| Corrected distance..... | 66 | 59 | 44 | Parallax in altitude 54...11 | | | | |
| | 66 | 8 | 8 | | | | — | |
| Third correction ..... | | + | 1 | | | | 1 | |
| True distance..... | 66 | 8 | 9 | | | | | |
| Distance at XVIII. hours | 65 | 54 | 23 | Intermediate Pro. Log... | | | 0.3391 | |
| Difference ..... | | 13 | 46 | ..... | Pro. Log... | | 1.1164 | |
| | | | | h. | m. | s. | | |
| | | | | 0 | 30 | 4... Pro. Log.... | 0.7773 | |
| Corr. for 0h.30m. and diff. of P.L. 10 (LIV.) | | | | | + | 2 | | |
| | | | | 0 | 30 | 6 | | |
| Time of distance from N. A..... | | | | 18 | | | | |
| Mean time at Greenwich ..... | | | | 18 | 30 | 6 April 3. | | |
| Mean time at ship, when dist. was observed | | | | 22 | 37 | 2 April 3. | | |
| Long. of the ship when the dist. was observed | | | | 4 | 6 | 56 = 61°44′ 0″ E. | | |

## EXAMPLE VII.

July 7, 1835, at 11h. 19m. P.M., apparent time, in latitude 46° 54′ N., and longitude by account 23° 36′ W., the distance of the moon's remote limb from the star $\alpha$ Aquilæ, or Altair, was observed to be 53° 12′ 50″; and at 16m. 49s. after (as measured by a good watch), the ship being in nearly the same place, the observed altitude of the star $\gamma$ Pegasi, or Algenib, was 15° 58′ East of the meridian, the height of the observer's eye being 24 feet, and the error of the sextant — 1′ 45″: required the true longitude of the ship.

## *To find the Mean Time at Ship when the Star Algenib was observed.*

| | h. | m. | |
|---|---|---|---|
| Apparent time at ship when distance was observed | 11 | 19 | P.M. |
| Interval of time by watch | + | 17 | |
| Apparent time at ship when star's altitude was observed | 11 | 36 | P.M. |
| Longitude by account, in time | 1 | 34 | W. |
| Apparent time at Greenwich when star's alt. was observed | 13 | 10 | |
| Equation of time | + | 5 | |
| Mean time at Greenwich by acc. | 13 | 15 | |

| | ° | ′ | ″ | |
|---|---|---|---|---|
| Star's declination Jan. 1834 | 14 | 15 | 38 | N. |
| Annual var. + 20″.05 × 1½ = | | + | 30 | |
| Star's declination, July 1835 | 14 | 16 | 8 | N. |
| | 90 | | | |
| Star's polar distance | 75 | 43 | 52 | |

| | h. | m. | s. |
|---|---|---|---|
| Sun's R. A. July 7 (P. II. N. A.) | 7 | 3 | 21 |
| Correc. for Greenwich mean time, 13h. 15m. (XXII.) | + | 2 | 16 |
| Sun's R. A. at Greenwich time | 7 | 5 | 37 |

| | ° | ′ | ″ |
|---|---|---|---|
| Star's observed altitude | 15 | 58 | 0 |
| Index error | — | 1 | 45 |
| | 15 | 56 | 15 |
| Correction from Table XV. — 8′. 0 = | — | 8 | 0 |
| Star's true altitude | 15 | 48 | 15 |

| | h. | m. | s. |
|---|---|---|---|
| Star's right ascension Jan. 1834 | 0 | 4 | 42 |
| Annual viaration + 3s. 08 × 1½ = | | + | 5 |
| Star's right ascension July 1835, | 0 | 4 | 47 |

| | ° | ′ | ″ | | |
|---|---|---|---|---|---|
| Star's polar distance | 75 | 43 | 52 | Co-secant | 0.01361 |
| Ship's latitude | 46 | 54 | | Secant | 0.16541 |
| Star's true altitude | 15 | 48 | 15 | | |
| Sum | 138 | 26 | 7 | | |
| Half-sum | 69 | 13 | 3 | Co-sine | 9.55003 |
| Remainder | 53 | 24 | 48 | Sine | 9.90471 |

| | h. | m. | s. | | |
|---|---|---|---|---|---|
| Star's distance from the meridian | 5 | 27 | 57 | E. Log. | 9.63376 |
| Star's right ascension, + 24 hours | 24 | 4 | 47 | | |
| Right ascension of the meridian | 18 | 36 | 50 | | |
| Sun's right ascension at Greenwich time | 7 | 5 | 37 | | |
| Apparent time at ship when the Star α Pegasi, or Algenib, was observed | 11 | 31 | 13 | | |
| Equation at Greenwich time | + | 4 | 30 | | |
| Mean time at ship when the star's altitude was observed | 11 | 35 | 43 | July 7. | |
| Interval of time by the watch | — | 16 | 49 | | |
| Mean time at ship when the distance was observed | 11 | 18 | 54 | July 7. | |

| | m. | s. |
|---|---|---|
| Equation by N. A. July 7. | 4 | 24.7 |
| Corr. for 13h. 15m. (LI). | + | 5.3 |
| Equation at Green. time | 4 | 30.0 |

## *To find the apparent Altitude of the Star α Aquilæ, or Altair, when the Distance was observed.*

| | h. | m. | s. | |
|---|---|---|---|---|
| Mean time at ship when the distance was observed | 11 | 18 | 54 | |
| Long. of the ship by account in time (XIX.) | 1 | 34 | 24 | W. |
| Estim. mean time at Greenwich | 12 | 53 | 18 | |

| | h. | m. | s. |
|---|---|---|---|
| Star's right ascension Jan. 1834 | 19 | 42 | 41 |
| Annual variation + 2s. 93 × 1½ = | | + | 4 |
| Star's right ascension July 1835 | 19 | 42 | 45 |

| | h. | m. | s. | | ° | ′ | ″ |
|---|---|---|---|---|---|---|---|
| Sun's right ascen. (P. II. N. A.)... | 7 | 3 | 21 | Star's declination, January 1834, | 8 | 26 | 8N. |
| Corr. for Greenw. time 12h. 53m. | + | 2 | 12 | Annual variation $+8''.69\times1\frac{1}{2}=$ | | + | 13 |
| Sun's right ascen. at Greenw. time | 7 | 5 | 33 | Star's declination, July 1835 ... | 8 | 26 | 21N. |
| Mean time when distance was obs. | 11 | 18 | 54 | | | | |
| Right ascension of the meridian... | 18 | 24 | 27 | | | | |
| Star's right ascension ..... | 19 | 42 | 45 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Star's meridian distance ..... | 1 | 18 | 18 | .....Log. rising.... | 3.76190 |
| Ship's latitude ..... | 46°54′ N. | | | .....Co-sine ..... | 9.83460 |
| Star's declination ..... | 8 | 26 | N. | .....Co-sine ..... | 9.99528 |
| | | | Nat. number... 3906 | ...Log..... | 3.59178 |
| Difference ..... | 38 | 28 | ...Versed ..... 21703 | | |
| True zenith distance ..... | 41 | 56 | ...Versed ..... 25609 | | |
| | 90 | | | | |
| Star's true altitude ..... | 48 | 4 | | | |
| Refraction ..... | + | 1 | | | |
| Star's apparent altitude ..... | 48 | 5 | | | |

## *To find the Moon's apparent Altitude when the Distance was observed.*

| | h. | m. | s. | | ° | ′ | ″ | |
|---|---|---|---|---|---|---|---|---|
| Moon's R.A. at 12h. July 7, | 16 | 50 | 23 | (P.VI.N.A.) Moon's dec., at 12h. July 7, | 23 | 3 | 36 | S. {P.VI. N. A. |
| Ditto, at 13h. .... | 16 | 53 | 0 | Ditto, at 13h. ..... | 23 | 11 | 10 | S. |
| Variation in 1 hour ..... | 2 | 37 | Log.1.3604 | Variation in 1 hour..... | 7 | 34 | Log. .8992 | |
| Greenw. time after 12 hrs.. | 53 | 18 | Log.0.0514 | Greenw. time after 12 hours | 53m. | 18s. | Log. .0514 | |
| | h. | m. | s. | | ° | ′ | ″ | |
| Variation in 53m. 18s..... | + | 2 | 20 | Log.1.4118 Variation in 53m. 18s. .... | + | 6 | 43 | Log. .9506 |
| Moon's R. A. at 12h. July 7, | 16 | 50 | 23 | Moon's dec., at 12h. July 7, | 23 | 3 | 36 | S. |
| Ditto at Greenwich time.. | 16 | 52 | 43 | Ditto at Greenwich time .. | 23 | 10 | 19 | S. |

| | | | | | |
|---|---|---|---|---|---|
| | h. | m. | s. | | |
| Right ascen. of the merid. (as above) | 18 | 24 | 27 | | |
| Moon's right ascension ..... | 16 | 52 | 43 | | |
| Moon's meridian distance ..... | 1 | 31 | 44 | .....Log. rising... | 3.89785 |
| Ship's latitude ..... | 46°54′ N. | | | .....Co-sine ..... | 9.83460 |
| Moon's declination ..... | 23 | 10 | S. | .....Co-sine ..... | 9.96349 |
| | | | Nat. number... 4965 | ...Log. ..... | 3.69594 |
| Sum ..... | 70 | 4 | ...Versed .....65907 | | |
| True zenith distance ..... | 73 | 4 | ...Versed .....70872 | | |
| | 90 | | | | |
| Moon's true altitude ..... | 16 | 56 | | | |
| Correction from Table XXX..... | − | 54 | | | |
| Moon's apparent altitude..... | 16 | 2 | | | |

*To find the true Distance* (BY METHOD V.), *and thence the Longitude.*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ° | ′ | ″ | | | | |
| Observed distance by sextant ... | 53 | 12 | 50 | | | | |
| Index error ..... | − | 1 | 45 | | | | |
| Dist. corrected for index error... | 53 | 11 | 5 | | | | |
| Moon's semidiameter ..... | − | 16 | 26 | | | | |
| Moon's augmentation ..... | − | | 4 | | | | |
| Apparent distance..... | 52 | 54 | 35 | | | | |
| Correction for refraction ..... | + | 2 | 12 | | | | |
| Corrected distance..... | 52 | 56 | 47 | ...Sine..... | 9.9021 | ...Tangent ... | 0.1221 |
| Star's apparent altitude ..... | 48 | 5 | | ...Co-secant ... | 0.1284 | | |
| Moon's apparent altitude..... | 16 | 2 | | ...Co-secant ..... | | | 0.5588 |
| Moon's horizontal parallax ..... | 1 | 0 | 17 | ...Pro. Log. ... | 0.4751 | ..... | 0.4751 |
| First arch ..... | | 56 | 11 | ...Pro. Log.... | 0.5056 | | |
| Second arch ..... | | 12 | 34 | ..... | | Pro. Log.... | 1.1560 |
| Correction for parallax..... | − | 43 | 37 | ..... | | 44′...13″ | XXXV. |
| Corrected distance..... | 52 | 56 | 47 | Parallax in altitude | 58 | ...22 | |
| Third correction ..... | 52 | 13 | 10 | | | | |
| | + | | 9 | ..... | | 9 | |
| True distance..... | 52 | 13 | 19 | | | | |
| Distance at XII. h. by N. A. ... | 52 | 37 | 3 | Intermediate Pro. Log.... | | | 3569 |
| Difference ..... | | 23 | 44 | ..... | | Pro. Log.... | 8799 |
| | | | | h. | m. | s. | |
| | | | | 0 | 53 | 59 ...Pro. Log.... | 5230 |
| Correction for 0h. 54m. and diff. P. L. 77 (LIV.) ..... | | | | | − | 20 | |
| | | | | 0 | 53 | 39 | |
| Time of distance by N. A. ..... | | | | 12 | | | |
| Mean time at Greenwich ..... | | | | 12 | 53 | 39 July 7. | |
| Mean time at place of observed distance ..... | | | | 11 | 18 | 54 July 7. | |
| Longitude (in time) at place of observed distance ..... | | | | 1 | 34 | 45 = 23° 41′ 15″ W. | |

## EXAMPLE VIII.

January 23, 1835, at about 0h. 46m. P.M., apparent time at ship, in latitude 40° 16′ S., and longitude by account 92° E., the following observations were taken of the sun and moon, with the corresponding times by a chronometer.*

On the same day, when the same chronometer shewed 9h. 44m. 40s. mean time, the altitude of the sun's lower limb was 43° 11′ 30″, the ship having, since the first observations were made, run 30 miles of longitude to the eastward, but remained in the same latitude: required the true longitude of the ship when the distances were observed, the height of the observer's eye being 16 feet, and the error of the sextant 2′ 15″ to subtract.

* For the method of taking the altitudes and distances without assistants, see page 229. —See also Explanation to Table XXXIV.

| Mean of times. 7h. 3m. 30s. | Times per Chron. h. m. s. | | ° ′ ″ | Mean distance. |
|---|---|---|---|---|
| | 6 54 42 | Altitude of sun's lower limb..... | 67 18 0 | |
| | 6 57 19 | Altitude of moon's upper limb... | 13 57 0 | |
| | 7 1 14 | Distance of nearest limbs ..... | 71 57 0 | 71° 55′ 40″ |
| | 7 3 48 | Distance of nearest limbs ..... | 71 55 50 | |
| | 7 5 28 | Distance of nearest limbs ..... | 71 54 10 | |
| | 7 9 21 | Altitude of moon's upper limb... | 11 40 0 | |
| | 7 12 4 | Altitude of sun's lower limb..... | 65 53 0 | |

## *To reduce the Altitude of the Sun to the Time corresponding to the mean Distance.*

| | h. m. s. | | h. m. s. | | ° ′ |
|---|---|---|---|---|---|
| Time of sun's first alt. | 6 54 42 | Time of sun's first alt. | 6 54 42 | Sun's first alt. ... | 67 18 |
| Time of sun's last alt. | 7 12 4 | Mean of times by chron. | 7 3 30 | Sun's last alt..... | 65 53 |
| Differences ..... | 17 22 | | 8 48 | | 1 25 |

| | | | |
|---|---|---|---|
| As | 17m. 22s. | Pro. Log. (Arith.Comp.)* | 8.9844 |
| Is to | 8 48 | Pro. Log. | 1.3108 |
| So is | 1° 25′ | Pro. Log. | 0.3259 |
| | ° ′ ″ | | |
| To decrease of sun's altitude ..... | 0 43 4 | Pro. Log. | 0.6211 |
| Sun's first observed altitude ..... | 67 18 0 | | |
| Sun's alt. at mean of times..... | 66 34 56 | | |

## *To reduce the Altitude of the Moon to the Time corresponding to the mean Distance.*

| | h. m. s. | | h. m. s. | | ° ′ |
|---|---|---|---|---|---|
| Time of moon's first alt. | 6 57 19 | Time of moon's first alt. | 6 57 19 | Moon's first alt. | 13 57 |
| Time of moon's last alt. | 7 9 21 | Mean of times by chron. | 7 3 30 | Moon's last alt. | 11 40 |
| Differences..... | 12 2 | | 6 11 | | 2 17 |

| | | | |
|---|---|---|---|
| As | 12m. 2s. | Pro. Log. (Arith. Comp.)* | 8.8251 |
| Is to | 6 11 | Pro. Log. | 1.4640 |
| So is | 2° 17′ | Pro. Log. | 0.1186 |
| | ° ′ ″ | | |
| To decrease of moon's altitude . | 1 10 24 | Pro. Log. | 0.4077 |
| Moon's first observed altitude... | 13 57 0 | | |
| Moon's alt. at mean of times ... | 12 46 36 | | |

## Hence we obtain the following set of observations:

| Mean of times by Chron. | Dist. nearest L. of ⊙ & ☽. | Alt. of ⊙'s L. L. | Alt. of ☽'s U. L. |
|---|---|---|---|
| 7h. 3m. 30s. | 71° 55′ 40″ | 66° 34′ 56″ | 12° 46′ 36″ |

* The Arithmetical Complement is found by subtracting the Proportional Logarithm from 10 0000.

## *To find the true Distance* (BY METHOD V.), *and thence the mean Time at Greenwich.*

Moon's horizontal parallax at Greenwich time 59′ 8″.

| | h. m. | | | o ′ ″ |
|---|---|---|---|---|
| Time at ship past noon, Jan. 22 | 24 46 | | Obs. alt. of the sun's lower limb ... | 66 34 56 |
| Long. by acc. in time (XIX). | 6 8 E. | | Dip of the horizon..... | − 3 50 |
| Time at Greenwich by acc.... | 18 38 Jan. 22. | | | 66 31 6 |
| | | | Sun's semidiameter by N. A. ..... | + 16 16 |
| | o ′ ″ | | Sun's apparent altitude..... | 66 47 22 |
| Observed distance..... | 71 55 40 | | | |
| Index error ..... | − 2 15 | | | o ′ ″ |
| | 71 53 25 | | Obs. alt. of the moon's upper limb. | 12 46 36 |
| Sun's semidiameter ..... | + 16 16 | | Dip of the horizon..... | − 3 50 |
| Moon's semidiameter ..... | + 16 7 | | | 12 42 46 |
| Moon's augmentation ..... | + 4 | | Moon's augmented semidiameter . | − 16 11 |
| Apparent distance ..... | 72 25 52 | | Moon's apparent altitude ..... | 12 26 35 |
| Correction for refraction ..... | + 3 50 | | | |
| Corrected distance ..... | 72 29 42 | ...Sine ..... 9.9794 | .....Tangent ... | 0.5013 |
| Sun's apparent altitude ..... | 66 47 | ...Co-secant ... 0.0367 | | |
| Moon's apparent altitude..... | 12 27 | ...Co-secant ..... | | 0.6664 |
| Moon's horizontal parallax ..... | 59 8 | ...Pro. Log. ... 0.4834 | ..... | 0.4834 |
| First arch ..... | 56 59 | ...Pro. Log. ... 0.4995 | | |
| Second arch ..... | 4 1 | ..... | Pro. Log... | 1.6511 |
| Correction for parallax..... | − 52 58 | .....53′ ... 8″ | } (XXXV). | |
| Corrected distance ..... | 72 29 42 | Parallax in altitude...58 ... 9 | | |
| | 71 36 44 | | | |
| Third correction ..... | + 1 | ..... | 1 | |
| True distance ..... | 71 36 45 | | | |
| Distance at XVIII h. by N. A. ... | 71 58 41 | Intermediate Pro. Log..... | 2641 | |
| Difference ..... ..... | 21 56 | .....Pro. Log..... | 9142 | |
| | | h. m. s. | | |
| | | 0 40 17...Pro. Log..... | 6501 | |
| Time of distance by N. A. ..... | | 18 | | |
| Mean time at Greenwich ..... | | 18 40 17 Jan. 22. | | |

## *To find the mean Time at Ship, and thence the Longitude.*

| | h. m. s. | | | o ′ ″ |
|---|---|---|---|---|
| Time by chronom. when distance was taken ... | 7 3 30 | | Sun's dec. Jan. 22 (P. II. of N.A.) | 19 46 26 S. |
| Do. when time-alt. was obs. | 9 44 40 | | Cor. for Gr. time 12h. 0m. (XXI) | − 6 36 |
| | | | Ditto, 9h.21m..... | − 5 9 |
| Interval between the obs.. | 2 41 10 | | | |
| Time at Greenwich when distance was taken ... | 18 40 17 | | Sun's declin. at Greenwich time.. | 19 34 41 S. |
| | | | | 90 |
| Do. when time-alt. was obs, | 21 21 27 Jan. 22. | | Sun's polar distance ..... | 70 25 19 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | ° | ′ | ″ | |
| | | | Obs. alt. of sun's lower limb | 43 | 11 | 30 | |
| | | | Index error ..... | − | 2 | 15 | |
| | | | | 43 | 9 | 15 | |
| | | | Corr. Table IX. + 11′. 4 = | + | 11 | 24 | |
| | m. | s. | | | | | |
| Eq. of time by N. A. | 11 | 49.4 | Sun's true altitude..... | 43 | 20 | 39 | |
| Corr. for 21h. 21m... | + | 14.0 | Sun's polar distance ..... | 70 | 25 | 19 | ...Co-secant... 0.02586 |
| | | | Ship's latitude..... | 40 | 16 | | ...Secant ..... 0.11745 |
| Eq. at Greenw. time | 12 | 3.4 | Sum ..... | 154 | 1 | 58 | |
| | | | Half-sum ..... | 77 | 0 | 59 | ...Co-sine ... 9.35154 |
| | | | Remainder ..... | 33 | 40 | 20 | ...Sine ..... 9.74389 |
| | | | | h. | m. | s. | |
| App. time at ship when the time-altitude was observed ... | | | | 3 | 16 | 48 | ...Log..... 9.23874 |
| Equation at Greenwich time ..... | | | | + | 12 | 3 | |
| Mean time at ship when the time-altitude was observed... | | | | 3 | 28 | 51 | Jan. 23. |
| | | | | 24 | | | |
| Ditto ..... ditto ..... | | | | 27 | 28 | 51 | Past noon, Jan. 22. |
| Mean time at Greenw. when the time-altitude was taken.. | | | | 21 | 21 | 27 | Ditto. |
| | | | | | | ° | ′ |
| Longitude in time when the time-altitude was observed... | | | | 6 | 7 | 24 | = 91 51 E. |
| Difference of longitude during the interval..... | | | | | | − | 30 E. |
| Longitude of ship when the distance was observed ..... | | | | | | 91 | 21 E. |

## EXAMPLES FOR EXERCISE.

1. June 16, 1835, in latitude 29° 8′ N., and longitude by account 147° 15′ W., about 20h. 32m. (being June 17, at 8h. 32m. A. M. civil time), the distance between the sun and moon was observed to be 92° 50′ 45″; at the same time the altitude of the moon's upper limb was 39° 1′ 20″; and the altitude of the sun's lower limb, 42° 36′ 20″; the height of the observer's eye being 18 feet, and the instruments adjusted: required the true longitude of the ship.

Answer. The true distance 92° 43′ 57″; mean time at Greenwich, 30h. 20m. 33s. past noon of June 16; mean time at ship, 20h. 29m. 41s., and longitude of the ship, 147° 43′ 0″ West.

2. January 16, 1835, (A. M. civil time), in latitude 8° 25′ S., and longitude by account 90° 30′ W., when a chronometer, which was 22m. 37s. *fast* for Greenwich mean time, shewed 6h. 44m. (being A. M. at Greenwich) the distance of the moon's remote limb from the Star Aldebaran, or α Tauri, was observed to be 66° 12′ 30″, the altitude of the moon's lower limb being 57° 22′ 25″, the altitude of the star (westward of the meridian) 32° 28′ 10″, the height of the observer's eye 14 feet, and the instruments adjusted: required the true longitude of the ship by the lunar observation and chronometer.

Answer. The true distance 65° 45′ 51″; the mean time at Greenwich, 18h. 20m. 48s.; the mean time at ship, 12h. 17m. 11s.; the longitude of

the ship by the lunar observation, 90° 54′ 15″ W., and by the chronometer, 91° 3′ 0″ West.

3. November 7, 1835, in latitude 40° 1′ 30″ N., and longitude by account 6° 35′ E., when a chronometer, which was 4m. 26s. *slow* for Greenwich mean time, shewed 11h. 54m. 32s. P. M., the angular distance of the moon's nearest limb from the centre of the Planet Jupiter was 32° 49′ 5″; at the same time the altitude of the moon's lower limb was 66° 32′; and the altitude of the planet's centre 41° 5′ (east of the meridian); the height of the observer's eye being 22 feet, and the error of the sextant which measured the distance — 4′ 20″: required the mean time at the meridian of the ship by the planet's altitude, and the longitude when the distance was observed, by the lunar observation and chronometer.

Answer. The true distance 33° 11′ 48″; the mean time at Greenwich 11h. 59m. 45s.; the mean time at ship 12h. 24m. 50s.; the longitude by the lunar observation 6° 16′ 15″ E., and by the chronometer 6° 28′ E.

4. December 13, 1835, (A. M. civil time), in latitude 10° 15′ N., and longitude by account 116° E., when a chronometer, which was 25m. 44s. *slow* for mean time at Greenwich, shewed 2h. 40m. 46s. A. M., the angular distance between the sun and moon's nearest limbs was 91° 1′ 20″, the altitude of the sun's lower limb 52° 32′ 30″, and the altitude of the moon's upper limb 18° 19′ 30″, (westward of the meridian); the height of the observer's eye being 22 feet, and the instruments adjusted; required the mean time at ship by the altitude of the moon, and the longitude by the lunar observation and chronometer.

Answer. The true distance 90° 50′ 1″; the mean time at Greenwich 15h. 7m. 32s. December 12; the mean time at ship 22h. 54m. 21s. December 12; the longitude by the lunar observation 116° 42′ 15″ E., and by the chronometer 116° 57′ 45″ E.

5. August 30, 1835, (A. M. civil time), in latitude 33° 31½′ N., when a chronometer, which was 12m. 50s. *fast* for mean time at Greenwich, shewed 5h. 59m. 43s. A. M., the altitude of the sun's lower limb was 27° 47′ 10″; and at P. M. ship-time, when the same chronometer shewed 11h. 52m. 50s. A. M., the distance between the sun and moon was observed to be 82° 56′ 40″; the altitude of the sun's lower limb being at the same time 53° 30′ 45″; the altitude of the moon's upper limb 13° 20′ 30″; the height of the observer's eye 18 feet, and the instruments adjusted: required the true longitude of the ship when the sun's altitude was taken for time, both by the lunar observation and chronometer.

Answer. The mean time at the meridian of the ship when the sun's altitude was observed for time, 19h. 50m. 39s. August 29, consequently the chronometer was 1h. 50m. 56s. *slow* for that meridian; the true distance 82° 45′ 38″, and the corresponding Greenwich mean time 23h. 39m. 52s. August 29; the mean time at ship 25h. 43m. 46s. past noon, August 29; and hence the longitude by the lunar observation, 30° 58′ 30″ E., and by the chronometer 30° 56′ 30″ East.

6. July 14, 1835, (A. M. civil time), in latitude 16° 35′ S., at 3h. 10m. 24s. P. M., by a chronometer which was 20m. 28s. *slow* for mean time at

Greenwich, the distance of the moon's nearest limb from the Star $\alpha$ Arietis was 50° 10′ 10″, the altitude of the star being 42° 17′ 45″, and the altitude of the moon's upper limb, 77° 27′ 30″; and at 7h. 0m. 50s. P. M. by the same chronometer, the altitude of the sun's lower limb was 22° 49′ 30″, the ship being then in latitude 16° 8′ S., the height of the observer's eye at each observation 12 feet, and the instruments adjusted: required the true longitude of the ship, by the lunar observation and chronometer, when the sun's altitude was taken, to determine the error of the chronometer in mean time at that meridian.

Answer. The true distance 50° 23′ 8″; mean time at Greenwich when the distance was observed, 27h. 31m. 43s. past noon, July 13; mean time at ship, when the sun's altitude was observed for time, 20h. 19m. 47s.; consequently the chronometer was then *fast* at that meridian 10h. 41m. 3s.; mean time at that meridian when the distance was taken, 16h. 29m. 21s.; and the longitude of the ship 165° 35′ 30″ W. By the chronometer the longitude of the ship was then 165° 22′ 45″ W.

7. October 9, 1835, in latitude 38° 45′ N., and longitude by account 72° 35′ W., about 5h. 0m. P. M., the altitude of the sun's lower limb was 9° 17′ 10″, when a chronometer, whose daily *loss* was 12ˢ.5, shewed 10h. 9m. 44s.; and about 3h. 32m. afterwards, when the same chronometer shewed 1h. 41m. 54s. A. M. October 10, (that is 13h. 41m. 54s. October 9, astronomical time), the observed distance of the moon's remote limb from the Star $\alpha$ Pegasi, or Marcab, was 64° 40′ 10″, the ship having run between the observations S. W. by S. (true) 28 miles; the index error of the sextant being + 2′ 15″, and the height of the observer's eye 18 feet: required the true longitude of the ship when the distance was taken.

Answer. The mean time at the ship when the sun's altitude was observed, 4h. 44m. 20s.; mean time at the place where the distance was taken, 8h. 15m. 16s.; the latitude by account when the distance was observed, 33° 22′ N., and the longitude by account 72° 54′ W.; the star's apparent altitude being 60° 0′, the moon's apparent altitude 7° 18′, and the true distance 63° 45′ 13″; the corresponding mean time at Greenwich 13h. 8m. 55s., and consequently the longitude of the ship at the place where the distance was observed, 73° 24′ 45″ West.

8. October 30, 1835, in latitude 52° 26′ S., and longitude by account 133° 45′ E., at about 5h. 20m. P. M., the altitude of the sun's lower limb was 15° 50′ 45″, and at 7m. 36s. after the sun's altitude was observed, the distance of the sun and moon's nearest limbs (measured by the same sextant) was 110° 44′ 40″; the index error of the instrument being 1′ 30″ to subtract, and the height of the observer's eye 24 feet: required the true longitude of the ship.

Answer. The mean time at ship when the sun's altitude was observed, 5h. 9m. 31s., and when the distance was taken, 5h. 17m. 7s. October 30, or 29h. 17m. 7s. past noon, October 29; the sun's apparent altitude 17° 18′; the moon's apparent altitude 43° 27′; and the true distance 110° 45′ 2″; the corresponding mean time at Greenwich, 20h. 24m. 16s. October 29 and consequently the true longitude of the ship, 133° 12′ 45″ W.

METHOD OF KEEPING

# A JOURNAL AT SEA.

A SEA JOURNAL is a book wherein is registered an exact and regular account of the various occurrences that happen on board a ship during her voyage; but more particularly those concerning the ship's way, in order that her situation may be known at any time required.

For this purpose there is kept in the steerage, or some other convenient part of every ship, a large board, painted black, called the *Log Board*, which is usually divided into six columns; the first, on the left hand, contains the 24 hours from the noon of one day to the noon of the following; the second and third columns are for the knots and fathoms the ship runs in half a minute, or the miles and parts in an hour;* the fourth column contains the courses steered by the compass; in the fifth the winds are entered; and in the sixth the various remarks, such as the state of the weather, the sails set or taken in, the observations made for ascertaining the ship's place, the variation of the compass, and whatever else may be thought necessary. All these particulars are entered every day at noon into a book, divided into columns exactly like the log-board, and called the *Log Book*. From this book the navigator makes the necessary deductions, relating to the ship's place, every day at noon; which operation is called a *Day's Work*.

While the ship is in port, the remarks entered in the log-book are called *Harbour Work*; and the account of the ship's way, &c., kept at sea, is termed *Sea Work*.

In harbour-work the day is estimated according to the civil reckoning, as on shore, that is, from midnight to midnight; but at sea, the days' works being made up at noon, are dated the same as the civil day, so that the days' works marked Monday, began on Sunday at noon, and ended on Monday at noon; hence the day by the ship's reckoning, which is called the nautical day, begins twelve hours before the civil day;† the first twelve hours, or those contained between noon and midnight, being marked P. M., signifying post meridiem, or afternoon; and the other twelve hours, A. M., signifying ante meridiem, or before noon.‡

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* In the Royal Navy, and on board ships that undertake an East India, or other long voyage, the log is hove every hour, but in short trading vessels only once every two hours. This last circumstance makes no difference in the computation, excepting that the knots and fathoms run on every course by the log, must be doubled, to give the whole distance.

† In compliance with an order from the Admiralty, the Navy Logs are dated at midnight, in order to correspond with the civil mode of reckoning time. The form of a Navy Log will be shewn hereafter.

‡ As the astronomical day begins at noon of the civil day, which is the end of the nautical day, the declination of the sun, used in determining the latitude by a meridian altitude, is taken out from the Tables or the Nautical Almanac, for the noon of the civil day.

When a ship is bound from one place to another that lies so far from her that she is obliged to leave the land, at the time of losing sight of it, the bearing of some place is to be observed, whose latitude and longitude are known; which, together with the estimated distance of the ship from the land, is to be set down on the log-board. This is called *taking a departure*. The distance may, however, be more accurately known by taking the bearing twice, and noting the ship's course and distance between them, as shewn in the first example of Oblique Sailing, page 112.

## TO CORRECT THE COURSES STEERED BY COMPASS.

The variation of the compass, which is usually found by observation, as already explained, must be applied to all courses steered, and on all bearings taken by the compass, in the following manner. Suppose yourself placed at the centre of the compass, and looking directly forward to the point you are to allow the variation from; then, if the variation be easterly, allow it to the right hand of the course steered, or bearing taken by compass; but if westerly, to the left hand; by which you will obtain the true course.

For example, suppose the course steered by compass is N. E. by N., and the variation is 1 point westerly; now, 1 point to the left hand of N.E. by N. is N. N. E., which is the true course required. Again, suppose I set a cape, and find it bear from me S. W. by compass, the variation being $1\frac{1}{2}$ point easterly; here $1\frac{1}{2}$ point allowed to the right hand of S. W. will give S. W. by W. $\frac{1}{2}$ W., the true bearing of the land.

The courses must likewise be corrected for leeway, the nature of which may be thus explained. When a ship is close hauled, and the wind blowing fresh, that part of the wind which acts upon the hull and rigging, together with a considerable part of the force exerted on the sails, tend to drive her immediately from the direction of the wind, or, as it is termed, to leeward. But since the bow of a ship exposes less surface to the water than the side, the resistance will be less in the first case than in the second; the velocity, therefore, in the direction of her head, will, in most cases, be greater than the velocity in the direction of her side, and the ship's real course will be between the two directions. Now the angle contained between the line of the ship's apparent course, and the line she really describes through the water, is termed her *Leeway*.

The quantity of leeway to be allowed, will depend upon a variety of circumstances; as the mould or trim of the ship; the quantity of sail she carries; her velocity through the water; the sails being properly set to receive the action of the wind, &c.: hence no general rules can be laid down with accuracy that will determine the quantity of leeway at all times. The following have, however, been usually given by most writers on Navigation.

1. When the ship is close-hauled, has all her sails set, the water smooth, with a light breeze of wind, she is then supposed to make little or no leeway.
2. When the top-gallant sails are handed, allow one point;
3. When under double-reefed topsails, one point and a half;

4. When under close-reefed top-sails, two points;
5. When the top-sails are handed, three points and a half:
6. When the fore-course is handed, four points;
7. When under the main-sail only, five points;
8. When under the balanced mizen, or mizen stay-sail, six points;
9. When under bare poles, seven points.

As these allowances depend entirely on the quantity of sail set, and the heave of the sea, without having any regard to the form of the ship, or nature of the cargo she may have on board, it is evident they can only be considered as probable conjectures, and may indeed serve to work up the day's work of a Journal that has been neglected. But since the computation of a ship's way depends much upon the accuracy of this allowance, it should always be the duty of the officer of the watch carefully to observe the leeway, and either allow it upon the courses steered before they are put down on the log-board, or else set it down in a column reserved for that purpose.

The leeway that a ship makes may be easily estimated thus: draw a small semicircle on the taffrail, with its diameter at right angles to the ship's keel, and divide its circumference into points and quarters; then observe the angle contained between the semidiameter which points right aft, and that which points in the direction of the wake, and it will be the leeway required. But the most accurate method of determining the leeway, is to have a semicircle drawn on the taffrail, as before described, with a low crutch or swivel in its centre. Then, after heaving the log, the line is to be slipped into the crutch just before it is drawn in, and the points and quarters contained between the direction of the log-line and the fore and aft line of the semicircle, will be the quantity of leeway.

The leeway being determined, it is to be allowed *from the wind*, that is, to the right hand of the course steered, when the larboard tacks are aboard, and to the left hand when the starboard tacks are aboard,* supposing yourself looking from the centre of the compass towards that point the ship's head is directed to. For example, suppose a ship sails S. W. by S. by compass, with her starboard tacks aboard, and she makes one point leeway; her course corrected for leeway will be S. S. W., being one point to the left of her course by compass. Again, if a ship close-hauled sails N. E. when the wind is N. N. W., and makes $1\frac{1}{2}$ point leeway, her true course will be N. E. by E. $\frac{1}{2}$ E.; because, having her larboard tacks aboard, $1\frac{1}{2}$ point is to be counted to the right hand of the course by compass.

The Examples in the following Table, where the courses steered, with the leeway and variation to be allowed on each, are given, from thence to find the true courses, will serve to exercise the learner in the foregoing rules.

---

* When a ship is close-hauled, certain ropes, called *tacks*, which are fastened to the lower corners of the main and foresails, are hauled forward on the weather side, or that next the wind, in which case those tacks are said to be aboard. When a ship is close-hauled, that is, when she sails as near the wind as she will lay, with the wind on the right hand, she has her starboard tacks aboard, and is said to sail on the starboard tack. But if the wind be on the left hand, in the same manner she has her larboard tacks aboard, and is said to sail on the larboard tack.

| GIVEN. | | | | TO FIND. |
|---|---|---|---|---|
| Courses steered. | Winds. | Leeway. | Variation. | Courses corrected. |
| E. N. E. | N. W. | | 1½ W. | N. E. ½ E. |
| W. by S. | N. W. by N. | 1 | | W. S. W. |
| N. W. by N. | N. E. by N. | 1½ | 2 W. | W. N. W. ½ W. |
| South. | E. S. E. | ½ | 1¼ E. | S. by W. ¾ W. |
| N. W. | W. S. W. | 2 | 1 W. | N. W. by N. |
| S. S. W. | S. E. | 1¼ | 1¼ W. | S. S. W. |
| E. by N. | N. by E. | 2½ | 0¾ E. | S. E. by E. ¾ E. |
| West. | N. N. W. | ¾ | 1 E. | W. ¼ N. |

In hard blowing weather, with a contrary wind and a high sea, it is impossible to gain any advantage by sailing; in such cases, therefore, the object is to avoid, as much as possible, being driven back. With this intention it is usual to lie-to under no more sail than is sufficient to prevent the violent rolling which the vessel would otherwise acquire, to the endangering of the masts, yards, and rigging. When a ship is brought-to, the tiller is put gradually over to leeward, which brings her head round to the wind.* The wind then having very little power on the sails, the ship loses her way through the water, which ceasing to act upon the rudder, her head falls off from the wind, the sail which she has set fills, and gives her fresh way through the water; which, acting on the rudder, brings her head again to the wind. Thus, the ship has a kind of vibratory motion, coming up to the wind, and falling off from it, alternately.

When a ship is lying-to, observe the points on which she comes up and falls off, and take the middle point for the apparent course; on which allow the variation and leeway, and you will have the true direction of the drift. For example, suppose a ship lying-to under a main-sail, with her starboard tacks aboard, comes up E. by S., and falls off N. E. by E., there being one point westerly variation, and she makes 5 points leeway; what course does she make good? The middle point between E. by S. and N. E. by E. is E. by N., from which allowing 5 points to the left hand, because the starboard tacks are aboard, gives the course, corrected for leeway, N. N. E.; from which allowing 1 point to the left hand, because the variation is westerly, will give the true course N. by E.

In sailing along a coast, in a tide or current, particular care should be taken to observe its setting, which, with the variation allowed, is to be entered in the Traverse Table as a course, and its drift as a distance; the same is to be observed for the heave or swell of the sea.

* It may be here mentioned as a caution, that when the tiller is put over, it should be lashed within *half a turn* of the wheel, in order that the rudder may have free play; and on no account should the helm be put hard over to leeward, as that would endanger the rudder, pintles, and gudgeons, or might even loosen the stern-post, by heavy seas striking against the back of the rudder: many serious accidents have occurred for want of due precaution in this respect.

On leaving the land, the opposite point to its bearing from the ship, with the variation allowed, and the estimated distance from it, are to be set down in the Traverse Table as a course and distance.

The computation made from the several courses, corrected as above, and their corresponding distances, is called a *Day's Work*; and the ship's place, as deduced therefrom, is called her Latitude and Longitude by *Account* or *Dead Reckoning*.

If the course and distance made good by a ship, as estimated from the compass and the log, could be accurately ascertained, nothing more would be necessary in determining a ship's place at any time during her voyage; for the course and distance being known, the difference of latitude and longitude, and hence the latitude and longitude she is in, may be readily found by any of the methods shewn in the various sailings; but on account of the many accidents that attend a ship's way, such as swelling of the sea; different rates of sailing between the times of heaving the log; want of care at the helm; unknown currents; sudden squalls; improper allowances for variation and leeway; the inaccuracy of the glass and log-line, &c.; the latitude of the ship, as deduced from the reckoning, will frequently differ considerably from the latitude by observation, and hence the difference of longitude, and longitude in by account will be likewise erroneous. Now, as the latitude by observation is always depended on, it remains, therefore, to correct the ship's longitude by account. For this purpose, examine whether the log-line and half-minute glass be just; and if you find they are not, correct the distance by the rules given in pages 61 and 62, and with the corrected distance and the course, find a new difference of latitude and departure; then, if this difference of latitude applied to the latitude left, give a latitude nearly the same as by observation, the error may be considered as sufficiently corrected, and the difference of longitude is to be found with this new latitude or departure. But if there still remain a considerable difference between the latitudes by account and by observation, consider carefully if the leeway and variation have been properly allowed; whether the ship's motion may not have been affected by a current, or heave of the sea; and if so, make the best estimation you can for its setting and drift.

If, after all proper allowances are made for errors in distance, currents, &c., the latitude by account and observed latitude should still disagree, it is then recommended by some authors to correct further for supposed errors in the courses and distances. Thus, if the course be near the meridian, the error is supposed to arise from the distance; because the error in the course must be sensible, to make any considerable error in the difference of latitude; if the course be nearly east or west, then the error is supposed to result from the course, as an error in the distance must be very great, to make a considerable one in the latitude; but if the course be near 4 points, then the error in the latitude is attributed partly to the course, and partly to the distance. The rules founded upon these suppositions, it must be confessed, are, in general, little better than guess-work; and are, therefore, omitted in this Work, being deemed useless, and frequently leading to greater errors than those they are intended to correct.

Notwithstanding that all the supposed corrections be applied with the greatest care to the ship's reckoning, it is frequently found, on making the land after a long voyage, that the longitude deduced from the dead reckoning alone, will differ very considerably from the truth: a good navigator will therefore lose no opportunity of ascertaining the ship's place by celestial observations; carrying forward the latitude so found, by applying to it the difference of latitude made from day to day by the reckoning, and to the longitude determined by a lunar observation, the difference of longitude made by chronometer, until another observation be taken. A separate statement is usually made of the longitude by dead reckoning, and of that by observations.

## GENERAL RULES FOR WORKING A DAY'S WORK.

1. Enter in a Traverse Table the several courses steered, corrected for variation and leeway; and opposite each course place the whole distance run, as it appears by the log on summing up the knots and fathoms while the ship is on that course. Find the difference of latitude and departure answering to each course and distance, and set them down in their respective columns; then the difference between the sums of the northings and southings will be the difference of latitude made good, of the same name with the greater: and the difference between the sums of the eastings and westings will be the departure made good, of the same name with the greater quantity.

2. Seek in the several pages of the Traverse Table until the above difference of latitude and departure be found together in their respective columns: opposite to these will be the distance made good; and at the top or bottom of the page, according as the departure is less or greater than the difference of latitude, will be found the true course.

Or, it will save trouble, especially when the variation is given in degrees, and the ship has made several courses during the 24 hours, if the magnetic or compass courses (corrected for leeway only) be entered in the Traverse Table; then with these courses, and the distance run on each, find the corresponding difference of latitude and departure, which will give the *magnetic course*, and the distance made good in the whole day; this course then being corrected for variation, will give the *true course*, with which, and the distance already found, you will obtain the *true* difference of latitude and departure.

3. If the latitude from which the ship's departure be taken, or yesterday's latitude, be of the same name with the difference of latitude, add them together; if not, take their difference; the sum or remainder will be the latitude at noon, by account, of the same name with the greater.

4. Find the complement of the middle latitude between yesterday's and to-day's latitude, which take as a course in the Traverse Table, and seek for the departure in its column; then will the distance corresponding to these be the difference of longitude, of the same name as the departure.

Or, seek for the course made good, and for the meridional difference of latitude in a lat. column; then will the corresponding departure give the difference of longitude, as before.

5. If the longitude of yesterday be of the same name with the difference of longitude, add them together; if not, take their difference; the sum or remainder will be the longitude in, of the same name with the greater.

6. To find the bearing and distance of the intended port, or any other place, from the ship, find the complement of the middle latitude between the ship and the proposed place; which seek in the Traverse Table as a course: in that page where it is found, look for the difference of longitude in a distance column, opposite to which will be the departure in its proper column; with this departure and the difference of latitude, find the *true* course or bearing, and the distance as before.

Or, look for the meridional difference of latitude and difference of longitude, till they are found opposite each other in the lat. and dep. columns, and they will give the *true* course; this course and the proper difference of latitude in the lat. column, will give the distance in its proper column.

If the *magnetic* course or bearing be required, the variation must be allowed on the true bearing; to the right-hand, if the variation be westerly, or to the left-hand, if easterly.

There are various methods of keeping a Sea Journal, with regard to what deserves to be recorded, according to the sentiments of different persons: some approve of a journal including the log-book, each day's work at some length, and such occurrences as seem of most importance; while others prefer a short abstract of this long journal, containing little more than the course and distance run, the latitude and longitude in, and sometimes the bearing and distance to the intended port, for each day. There are likewise forms peculiar to the particular service to which a ship belongs, as in the Royal Navy and East India Merchant Service. These forms will be shewn hereafter.

We shall now proceed to exemplify the above Rules; first, by a few examples of separate Days' Works, and afterwards in a Journal from London to Madeira, kept in the form generally used in merchant ships, and containing most of the occurrences that happen to a ship in a common voyage, with supposed observations for ascertaining the latitude, longitude, variation, &c.

NOTE. In the following Days' Works and Journal, which are worked by inspection, the log is supposed to be hove every hour, and the knot divided into eight fathoms of six feet each. Also in all the astronomical observations introduced in this Journal, the height of the observer's eye is supposed to be 18 feet.

## EXAMPLE I.

Yesterday, at noon, we were, by observation, in latitude 19° N., and in longitude 23° 4′ W.; and have sailed till noon this day, as per log; the variation of the compass being 1 point West: required the course and distance made good, with the present latitude and longitude of the ship.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks. |
|---|---|---|---|---|---|---|
| 1 | 5 | 4 | S. W. ½ W. | N. E. | | Moderate and clear, in the first and middle parts; latter, thick and cloudy, with drizzling rain. |
| 2 | 5 | 2 | | | | |
| 3 | 5 | 4 | | | | |
| 4 | 5 | | | | | |
| 5 | 5 | | | | | |
| 6 | 5 | | | | | |
| 7 | 4 | 6 | | | | A stranger, shewing English colours, in the N. E. quarter, standing to the southward. |
| 8 | 4 | | | | | |
| 9 | 4 | | | | | |
| 10 | 4 | | | | | |
| 11 | 3 | 4 | | | | |
| 12 | 3 | 4 | | | | |
| 1 | 4 | | N. W. | E. N. E. | | |
| 2 | 4 | | | | | |
| 3 | 3 | 2 | | | | |
| 4 | 3 | | | | | |
| 5 | 3 | 6 | S. W. | | | Set the fore-top-mast studding sail. |
| 6 | 5 | 2 | | | | |
| 7 | 5 | 4 | S. S. W. | | | An increasing breeze and cloudy, with rain. |
| 8 | 6 | | | | | |
| 9 | 7 | | | | | |
| 10 | 8 | | | | | |
| 11 | 7 | 4 | | | | |
| 12 | 7 | | | | | Variation 1 point West. |

| Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. W. ½ S. | 55 | | 42.5 | | 34.9 |
| N. W. by W. | 14 | 7.8 | | | 11.6 |
| S. W. by S. | 9 | | 7.5 | | 5.0 |
| S. by W. | 41 | | 40.2 | | 8.0 |
| | | 7.8 | 90.2 | Dep. | 59.5 |
| | | | 7.8 | | |
| | Diff. lat. | | 82.4 | | |

| | | | | | |
|---|---|---|---|---|---|
| Lat. left ..... | 19° | 0′ | N. ... | Mer. Parts | 116′ |
| Diff. of lat. 82′ = | 1 | 22 | S. | | |
| Lat. in. by acc. | 17 | 38 | N. ... | Mer. Parts | 1075 |
| Sum of lats.... | 36 | 38 | | | |
| Middle lat. ... | 18 | 19 | | Mer. diff. lat. | 86 |
| | 90 | | | | |
| Co. mid. lat. | 71 | 41 | | | |

The first course steered by compass, viz. S. W. ½ W., being corrected for 1 point West variation, makes the true course S. W. ½ S.; and the knots and fathoms, summed up to midnight, give the distance run upon the first course, 55 miles: in the same manner the other courses are to be corrected, and, with their corresponding distances, are to be set down in a Traverse Table, as above. No leeway is allowed on the courses in this day's work, because the ship is going large.

The whole difference of latitude 82′.4, and the departure 59′.5, give the course made good, S. 36° W., and the distance 102 miles.

The co. middle lat. 71° 41′ as a course, and the departure 59′.5 in a dep. column, give the diff. of longitude 62′.5 in a dist. column, by Middle Latitude Sailing.

Or, the course 36°, and mer. diff. of latitude 86′ in a lat. column, give the diff. of longitude 62′.4 in a dep. column, by Mercator's Sailing.

The difference of longitude 62 miles, or 1° 2′ W., added to the longitude of yesterday, 23° 4′ W., because they are both of the same name, gives the longitude in to-day 24° 6′ W.

## EXAMPLE II.

Yesterday, at noon, we were in latitude 35° 2′ N., and longitude 17° 45′ W.; at 7 o'clock, P. M., the sun was observed to set W. 43° N. by compass, his declination being at that time 18° 56′ N.; and we have sailed this day till noon, as per log, in a current setting S. W. 1 mile per hour all day; required the course and distance made good, and our present latitude and longitude.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks. |
|---|---|---|---|---|---|---|
| 1 | 5 | | N. E. by N. | E. S. E. | | Moderate breezes. |
| 2 | 5 | 2 | | | | |
| 3 | 5 | 2 | | | | |
| 4 | 5 | | | | | |
| 5 | 5 | 4 | | | | |
| 6 | 5 | | | | | |
| 7 | 4 | 6 | | | | The sun set W. 43° N., by which the variation |
| 8 | 4 | 2 | | | | is found to be 19° 29′, or 1¾ point, West. |
| 9 | 5 | | | | | |
| 10 | 5 | | | | | |
| 11 | 5 | 2 | N. N. E. | East. | 1 | Fresh gales. In 2d. reef of the topsails. |
| 12 | 5 | | | | | |
| 1 | 4 | 6 | | | | |
| 2 | 4 | 2 | | | | |
| 3 | 3 | 6 | | | | |
| 4 | 3 | 4 | N. E. ¼ N. | E. by S. | 1¼ | |
| 5 | 3 | | | | | |
| 6 | 3 | | | | | |
| 7 | 3 | | | | | |
| 8 | 2 | 4 | | | | Cloudy. |
| 9 | 2 | | | | | |
| 10 | 2 | 4 | | | | |
| 11 | 2 | 4 | | | | |
| 12 | 2 | | | | | Lat. by obs. 36° 16′ N. |

Before the courses can be corrected, the variation of the compass must be found by the amplitude taken at sunset. Now the ship's course from noon to 7 o'clock is N. E. by N., and the distance run 36 miles: but allowing the variation at last observation to be about 1¼ point westerly, the corrected course will be N. by E. ¼ E.; with which, and the distance 36 miles, the diff. of latitude made good since noon is found to be 34′ N.: this, added to the latitude at noon, 35° 2′ N., gives the latitude in, at sunset, 35° 36′ N.; with which, and the declination 18° 56′ N., the true variation is found as follows:—

| | | | | |
|---|---|---|---|---|
| Latitude..... | 35° | 36′ | N.... | Secant 0.08986 |
| Declination... | 18 | 56 | N.... | Sine... 9.51117 |
| True amp. W. | 23 | 31 | N.... | Sine... 9.60103 |
| Mag. amp. W. | 43 | 0 | N. | |
| Variation .... | 19 | 29, | or 1¾ point West. | |

The courses being corrected for variation and leeway, with their corresponding distances, together with the set and drift of the current, will be as in the Traverse Table.

| Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| N. by E. ¼ E. | 50 | 48.5 | | 12.2 | |
| N. ¾ W. | 23 | 22.7 | | | 3.4 |
| N. ¼ E. | 24 | 24.0 | | 1.2 | |
| S. S. W. ¼ W. Current. | 24 | | 21.7 | | 10.3 |
| | | 95.2 | 21.7 | 13.4 | 13.7 |
| | | 21.7 | | | 13.4 |
| | Diff. lat. | 73.5 | | Dep. | 0.3 |

On summing up the columns of the Traverse Table, it appears that the ship has sailed due North: hence her distance made good is 73.5 miles, the same as the difference of latitude; and her longitude is the same as yesterday.

The difference of latitude 73.5 miles, or 1° 14′ N., added to the latitude left, 35° 2′ N., gives the latitude in, 36° 16′ N.

## EXAMPLE III.

Yesterday, at noon, we were in latitude 38° 20′ S., and longitude 10° 34′ E. At 5 o'clock in the afternoon, the sun's bearing by compass was observed to be N. 75° 10′ W., his corrected altitude being at the same time 22° 15′, and declination 18° 47′ S.; and we have sailed till this day at noon as per log: required the course and distance made good, the latitude and longitude in, with the course and distance to the Cape of Good Hope.

| H. | K. | F. | Courses. | Winds. | Leeway. | Remarks. |
|---|---|---|---|---|---|---|
| 1 | 6 | | E. S. E. | N. N. E. | | The first and latter part of these 24 hours a moderate breeze and cloudy; the middle, light airs and calms, attended with rain. |
| 2 | 5 | 4 | | | | |
| 3 | 6 | | | | | |
| 4 | 4 | | | | | |
| 5 | 1 | 6 | | | | |
| 6 | 0 | 6 | | | | |
| 7 | ) | | | | | |
| 8 | Calm | | | | | |
| 9 | ) | | | | | |
| 10 | 1 | | S. E. | Variable. | | |
| 11 | 3 | | | | | |
| 12 | 3 | | E. S. E. | S. by W. | | |
| 1 | 3 | | | | | |
| 2 | 4 | | | | | |
| 3 | 5 | 4 | | | | |
| 4 | 5 | 4 | | | | |
| 5 | 5 | | | | | |
| 6 | 5 | | | | | |
| 7 | 5 | | | South. | ¼ | In 1st. reefs of the topsails. |
| 8 | 4 | | | | | |
| 9 | 4 | 6 | | | | |
| 10 | 5 | 6 | | | | |
| 11 | 4 | | | | | |
| 12 | 4 | 4 | | | | No Observation. |

Supposing the variation of the compass at last observation to have been about 2 points westerly, the ship has sailed nearly due East from noon to 5h. P. M.; consequently the latitude at that time may be considered the same as at noon. Now, with the latitude 38° 20′ S., the altitude 22° 15′, and the declination 18° 47′ S., the true azimuth is found to be N. 96° 54′ W., which, compared with the magnetic azimuth, N. 75° 10′ W., gives the variation 21° 44′ W.

| Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. 89° E. | 55 | | 1.0 | 55.0 | |
| S. 67 E. | 4 | | 1.6 | 3.7 | |
| N. 85 E. | 28 | 2.4 | | 27.9 | |
| | | 2.4 | 2.6 | 86.6 | Dep |
| | | | 2.4 | | |
| | Diff. lat. | | 0.2 | | |

The several courses, corrected for variation to the nearest degree, and for leeway after 7 o'clock A. M., with their corresponding distances, will be as in the Traverse Table; but it is to be observed, that as the distance run from noon to 6h. P. M., and from 11h. P. M. to 6h. A. M., are on the same course, this course is to be corrected, and with the *sum* of the corresponding distances, 55 miles, entered in the Traverse Table as a *single course and distance*

By the Traverse Table, it appears that the ship has sailed due East: hence her departure is equal to the distance run, and the latitude to-day is the same as that of yesterday. The difference of longitude is found by Parallel Sailing, as follows:—

The co. latitude 51° 40′ as a course, and the departure 86′.6 in a dep. column, give the diff. of longitude 110′ in a distance column.

The diff. of longitude 110′, or 1° 50′ E. added to the longitude of yesterday 10° 34′ E., gives the longitude of the ship to-day at noon, 12° 24′ E.

***To find the Bearing and Distance of the Cape of Good Hope.***

**lat. of C. of G. Hope 34° 22′ S.....Mer. Parts... 2198 Long. of C. of G. Hope 18° 24′ E.**
**Latitude of ship..... 38 20 S.....Mer. Parts... 2494 Longitude of Ship..... 12 24 E.**

**Diff. of latitude. .... 3 58=238′ Mer. diff. lat. 296 Diff. of longitude ..... 6 0=360′.**

**Hence the bearing of the Cape of Good Hope is N. E. ¼ E., and the distance 375 miles. The course by compass is therefore N. 72° 22′ E., or E. N. E. ¼ E. nearly.**

## EXAMPLE IV.

Yesterday, at noon, we were in latitude 6° 38′ N., and longitude 26° 10′ W. At 7 o'clock this morning we observed the distance of the sun and moon, which gave our longitude at that time 26° 58′ W.; and, by double altitudes, we were in latitude 7° 47′ N. at 10h. 30m. A. M.: required the course and distance made good by the log, the latitude and longitude at noon by dead reckoning, and the same by the observations.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks. |
|---|---|---|---|---|---|---|
| 1 | 6 | | N. W. by N. | N. E. | | A pleasant breeze with fair weather throughout. |
| 2 | 6 | | | | | |
| 3 | 5 | | | | | |
| 4 | 5 | | | | | |
| 5 | 5 | 4 | | | | |
| 6 | 5 | 4 | | | | |
| 7 | 5 | | | | | |
| 8 | 5 | | | | | |
| 9 | 5 | | | N. E. by E. | | |
| 10 | 5 | | | | | |
| 11 | 4 | 6 | | | | |
| 12 | 4 | 4 | | | | |
| 1 | 5 | | | | | |
| 2 | 5 | 2 | | | | |
| 3 | 5 | | | | | |
| 4 | 5 | | | | | |
| 5 | 5 | | | | | |
| 6 | 5 | | | | | |
| 7 | 5 | 2 | | | | |
| 8 | 5 | 4 | | | | |
| 9 | 6 | 4 | | | | |
| 10 | 6 | | | | | |
| 11 | 6 | 2 | | | | |
| 12 | 6 | | | | | Variation by azimuth 8° W. |

The variation 8° W. being allowed to the left of N. W. by N., gives the corrected course N. 42° W.; and the knots and fathoms summed up, give the distance run by the log in 24 hours, 128 miles: hence the difference of latitude is 95′. 1, and the departure 85. 6 miles.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Latitude left..... | 6° | 38′ | N. | Latitude left..... | 6° | 38′ | N. |
| Diff. of latitude 95′, or | 1 | 35 | N. | Latitude in..... | 8 | 13 | N. |
| Latitude in by account | 8 | 13 | N. | Sum..... | 14 | 51 | |
| | | | | Middle latitude.. | 7 | 25 | |
| | | | | Com. of mid. lat. | 82 | 35 | |

The com. of middle latitude 82° 35′, and the departure 85′. 6, give the difference of longitude 86 miles, or 1° 26′; which, added to the longitude of yesterday, 26° 10′ W., gives the longitude in, by account, 27° 36′ W.

*To reduce the Observations to Noon.*

The course N. 42° W., and the distance run from 10h. 30m. A. M., till noon, viz. 9 miles, give the diff. of latitude 7′ N.; which added to the latitude by double altitudes 7° 47′ N., their sum, 7° 54′, is the latitude by observation reduced to noon.

The course N. 42° W., and the distance run since 7 o'clock in the morning, 30 miles, give the departure made in that interval 20′. 1, and the diff. of latitude 22′. 3.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lat. by observation at noon..... | 7° | 54′ | N. | Lat. at noon..... | 7° | 54′ | N. |
| Diff. of lat. from 7h. A.M. to noon | — | 22 | N. | Lat. at 7h. A. M... | 7 | 32 | N. |
| Lat. by obs. at 7h. A. M. ..... | 7 | 32 | N. | Sum..... | 15 | 26 | |
| | | | | Middle latitude... | 7 | 43 | |
| | | | | Com. of mid. lat. | 82 | 17 | |

The com. of middle latitude 82° 17′, and the departure 20′. 1, give the diff. of longitude made from 7h. A. M. to noon, 20′ W.; which added to 26° 58′ W., the longitude by the observation, their sum, 27° 18′ W., will be the long. by observation brought on to noon.

# JOURNAL

OF A

# VOYAGE FROM ENGLAND TO MADEIRA,

*IN THE SHIP*

# BRITANNIA,

## J. W. N. COMMANDER,

KEPT BY G. W. MATE.

1835.

| Date. | Winds. | Remarks on Board the Ship BRITANNIA, 1835. |
|---|---|---|
| Sunday, June 7. | S. S. W.<br>S. W. | Moderate and clear. At 6h. A. M. the Pilot came on board. At 8h. A. M. cast loose from the sheer hulk at Deptford, and made sail down the river. At 2h. P. M. anchored in Long Reach, and moored ship with a cable each way. |
| Monday, June 8. | W. by S. | Fresh gales with showers. P. M. received on board the carpenter's and boatswain's stores. |
| Tuesday, June 9. | S. S. W. to N. N. W. | Light airs and fine weather. At 6h. A. M. unmoored, and hove short on the best bower. At noon weighed with a light breeze from the westward. At 3h. P. M. came to with the best bower off Gravesend. Received a chronometer on board, which was 1m. 45s. slow for Greenwich mean time, and losing daily 2.5s. |
| Wednesday, June 10. | W. N. W. | Moderate weather and fair. At daylight weighed and made sail. At 1h. P. M. anchored with the best bower at the Nore, in 9 fathoms. At 5h. P. M. weighed and sailed through the Queen's Channel. At 8h. 30m. P. M. came to with the best bower at the back of Margate Sand. |
| Thursday, June 11. | N. by E.<br>N. | Moderate wind and cloudy, with showers. At 6h. A. M. weighed and made sail. At 8h. A. M. ran through the Gull Stream, and came to an anchor in the Downs, in 7 fathoms, about 1 mile off shore, Deal Castle bearing W. N. W., the South Foreland S. W., and the North Foreland N. N. E. P. M. the Pilot left the ship. |
| Friday, June 12. | N. N. E. | A pleasant breeze with fair weather throughout. A. M. employed filling up the water, stowing the booms and boats, and getting all clear for sea. At 10h. A. M. weighed and made sail. At noon the South Foreland upper Lighthouse bore N. N. W., distant about 4 miles<br>This log contains 12 hours, and ends at noon, to commence sea logs. |

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Saturday, June 13, 1835. |
|---|---|---|---|---|---|---|
| 1 | 1 | 2 | W.S.W.½W. | N. N. E. | | Light winds and clear. |
| 2 | 1 | 4 | | | | People employed variously under the Boatswain. |
| 3 | 2 | | | | | |
| 4 | 3 | | | | | Carpenter making a spare top-gallant yard. |
| 5 | 3 | 2 | | | | |
| 6 | 3 | 4 | | | | |
| 7 | 3 | | | | | |
| 8 | 3 | 4 | | | | |
| 9 | 2 | 4 | W. ¼ N. | | | |
| 10 | 2 | 4 | | | | Dungeness Light North. |
| 11 | 3 | | | | | |
| 12 | 3 | | | | | |
| 1 | 3 | 4 | | | | |
| 2 | 4 | | | | | |
| 3 | 4 | 2 | | | | |
| 4 | 4 | 2 | | | | Beachy Head revolving Light W. N. W. |
| 5 | 4 | 4 | | | | |
| 6 | 5 | | | | | In 1st. reef of the topsails. |
| 7 | 5 | 2 | | | | |
| 8 | 6 | 2 | | | | |
| 9 | 7 | | W.N.W.¼W. | N. E. | | Brisk gales. |
| 10 | 7 | 4 | | | | |
| 11 | 8 | | | | | |
| 12 | 8 | 4 | | | | Bembridge Point N.N.W. ¼ W. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude. Acc. | Obs. | Diff. long. | Longitude. Acc. | Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ☽ Chr. | |

| H. | K. | F. | Courses. | Winds. | Lee-way | Remarks, Sunday, June 14, 1835. |
|---|---|---|---|---|---|---|
| 1 | 8 | | W. N. W. | N. E. by N. | | Fresh breezes and fair throughout. |
| 2 | 8 | | | | | At ¼ past 1 abreast of St. Catherine's Point, off shore about 3 miles. |
| 3 | 8 | | | | | |
| 4 | 7 | 6 | | | | |
| 5 | 7 | 2 | | | | St. Aldan's Head N. W. ¼ W. |
| 6 | 7 | | West. | | | |
| 7 | 7 | | | | | |
| 8 | 6 | 4 | | | | |
| 9 | 6 | | | | | Portland Light N. N. W. |
| 10 | 6 | | | | | |
| 11 | 6 | | | | | |
| 12 | 6 | | | E. N. E. | | |
| 1 | 5 | | | | | |
| 2 | 5 | | | | | |
| 3 | 5 | 4 | | | | Out reefs of the topsails. |
| 4 | 5 | | | | | |
| 5 | 5 | | | | | |
| 6 | 5 | | | | | |
| 7 | 6 | | N. W. by W. | | | |
| 8 | 6 | 2 | | | | Two strange sail in sight on the weather bow, standing up channel. |
| 9 | 6 | | | | | |
| 10 | 6 | | | | | |
| 11 | 5 | | W. by N. | | | |
| 12 | 5 | | | | | At noon mustered the ship's company. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude. Acc. | Obs. | Diff. long. | Longitude. Acc. | Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ☽ Chr. | |

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Monday, June 15, 1835. |
|---|---|---|---|---|---|---|
| 1 | 5 | | W. by. N. | E. N. E. | | A brisk wind and clear, in the first and middle parts; latter thick, cloudy weather, with drizzling rain. |
| 2 | 5 | 4 | | | | |
| 3 | 6 | | | | | |
| 4 | 6 | | | | | |
| 5 | 5 | 2 | | | | |
| 6 | 4 | | | | | At 6 P. M. the Lizard bore N. E. by N. distant 3 leagues; from which I take my departure. |
| 7 | 4 | | | | | |
| 8 | 3 | 4 | | | | |
| 9 | 3 | 6 | | | | |
| 10 | 3 | | | | | |
| 11 | 3 | | | N. by W. | | |
| 12 | 3 | 6 | | | | |
| 1 | 4 | | | | | |
| 2 | 4 | 4 | S. W. ¼ W. | | | |
| 3 | 5 | | | | | |
| 4 | 5 | | | | | A. M. stowed the anchors, unbent the cables, and coiled them down in the tier. |
| 5 | 5 | | | | | |
| 6 | 4 | 4 | | | | |
| 7 | 4 | 6 | | | | |
| 8 | 5 | | | | | |
| 9 | 5 | | | | | |
| 10 | 6 | | | | | At noon sounded. Ground 76 fathoms; sand, shells, and hakes' teeth. |
| 11 | 5 | | | | | |
| 12 | 5 | 2 | | | | Variation 2¼ points West. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W Acc. | Longitude W Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 37° W. | 81′ | 65′ S. | 49′ W. | 48° 53′ | | 76′ W. | 6° 27′ | ☽ Chr. | |

As the Lizard is the last point of land in sight, the ship's departure is taken from thence, supposing it to be in latitude 49° 58′ N., and longitude 5° 11′ W.: now, as the bearing of the Lizard from the ship was N. E. by N., the bearing of the ship from the Lizard was S. W. by S.; but as this is the bearing by compass, the variation 2¼ points W. is to be allowed to the left hand, which will give the true bearing S. ¾ W.; this is to be entered in the Traverse Table as a course, and 3 leagues, or 9 miles, the supposed distance of the Lizard from the ship, as a distance run. The courses, corrected for variation, and the distance run by the log, after 6h. P. M., are also to be set down in the Traverse Table, as follows:—

| True Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. ¾ W. | 9 | | 8.9 | | 1.3 |
| W.S.W. ¾ W. | 25 | | 6.1 | | 24.3 |
| S.S.W. ¼ W. | 55 | | 49.7 | | 23.5 |
| | | Diff. lat. | 64.7 | Dep. | 49.1 |

The diff. of lat. 64′.7 S. and departure 49′.1 W. give the course made good from the Lizard S. 37° W., and the distance 81 miles.

| | | | | |
|---|---|---|---|---|
| Lat. of the Lizard | 49° 58′ | N. | Mer. Parts. | 3471 |
| Diff. of lat. 65m. or | 1 5 | S. | | |
| Lat. in by acc. | 48 53 | N. | Mer. Parts. | 3371 |
| Sum of latitudes | 98 51 | | | |
| Middle latitude | 49 25 | | Mer. diff. lat. | 100 |
| Co. mid. latitude | 40 35 | | | |

The course 37°, and the mer. diff. of lat. 100′, give the diff. of long. 75′.2; or the co. mid. lat. 40° 35′ as a course, and the departure 49′.1 in a dep. column, give the diff. of longitude in a dist. column 75.5 miles, or ..... 1° 16′ W.

Longitude of the Lizard ..... 5 11 W.

Longitude in by account ..... 6 27 W.

The course and distance made good, the whole diff. of lat. and departure, the lat. and long. in by account, &c. are now to be set down in their respective columns, as above.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Tuesday, June 16, 1835. |
|---|---|---|---|---|---|---|
| 1 | 5 | 4 | S. W. | N. by W. | | A moderate breeze with fair weather for the most part; latterly thick and cloudy. |
| 2 | 5 | | | | | |
| 3 | 5 | | | | | |
| 4 | 4 | 4 | | N.W. by N. | | |
| 5 | 4 | | | | | |
| 6 | 4 | | W. by S. | | ½ | |
| 7 | 4 | | | | | |
| 8 | 3 | 6 | | | | In 1st. reef of the topsails. |
| 9 | 3 | 2 | | | | |
| 10 | 3 | | | | | Tacked ship. |
| 11 | 3 | | N. W. by W. | S.W. by W. | 1 | |
| 12 | 3 | | | | | |
| 1 | 2 | | | | | |
| 2 | 2 | | | | | At 2h. A. M. the mer. alt. of the star α Aquilæ or Altair, was 50° 9′ S., which gives the lat. 48° 22′ N. |
| 3 | 3 | | | | | |
| 4 | 4 | | | | | |
| 5 | 4 | | | | | Tacked. |
| 6 | 4 | 4 | S. by E. | | ½ | |
| 7 | 4 | 4 | | | | Out reefs of the topsails. |
| 8 | 5 | | | | | |
| 9 | 5 | | | | | Tacked. |
| 10 | 5 | | West. | S. S. W. | ¼ | Spoke a brig, bound to Newfoundland. |
| 11 | 5 | | | | | |
| 12 | 5 | | | | | Variation 2¼ points West |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 42° W. | 64′ | 47′ S. | 42′ W. | 48° 6′ | 48° 6′ | 64′ W. | 7° 31′ | ☽ Chr. | Cape Finisterre, S. 13½° W., 319m. |

The courses corrected for variation and leeway, with their corresponding distances, will be as in the following Traverse Table.

| True Courses. | Dist | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. by W. ½ W. | 24 | | 22.6 | | 8.1 |
| S. W. ½ W. | 18 | | 12.1 | | 13.3 |
| W.N.W. ¼ W. | 21 | 7.1 | | | 19.8 |
| S. E. ½ S. | 19 | | 14.1 | 12.8 | |
| W. S. W. | 15 | | 5.7 | | 13.9 |
| | | 7.1 | 54.5 | 12.8 | 55.1 |
| | | | 7.1 | | 12.8 |
| | Diff. lat. | | 47.4 | Dep. | 42.3 |

With the diff. of latitude 47′.4 S. and the dep. 42′.3 W., the course is found to be S. 42° W., and the distance 64 miles.

| | | | | |
|---|---|---|---|---|
| Yesterday's lat. | 48° 53′ | N. | Mer. Parts... | 3371 |
| Diff. of lat..... | 47 | S. | | |
| Lat. in by acc.. | 48 6 | N. | Mer. Parts... | 3301 |
| Sum of lats. ... | 96 59 | | | |
| Middle lat. ..... | 48 29 | | Mer. diff. lat. | 70 |
| Co. mid. lat. ... | 41 31 | | | |

The latitude found by the star α Aquilæ at 2h. A. M. being brought forward by the log. from that time to noon, places the ship in latitude 48° 6′ N.

The course 42° and mer. diff. of lat. 70′, give the diff. of long. 63′; or the co. mid. lat. 41° 31′, with the dep. 42′.3, give the diff. of long. 64m., or ..... 1° 4′ W.

Yesterday's longitude..... 6 27 W.

Longitude in by account ..... 7 31 W.

*To find the Bearing and Distance of Cape Finisterre.*

Latitude of ship..... 48° 6′ N..... Mer. Parts... 3301 Longitude of ship ..... 7° 31′ W.
Lat. of C. Finisterre 42 56 N... .. Mer. Parts... 2858 Long. of C. Finisterre 9 16 W.

Diff. of latitude..... 5 10 = 310′. Mer. diff. lat. 443 Diff. of longitude 1 45 = 105′.

The mer. diff. lat. 443′, and diff. of long. 105′, give the true course or bearing S. 13½° W.; which course, and the proper diff. of lat. 310m., give the distance 319 miles. The magnetic or compass bearing is S. W. ¼ S. nearly.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Wednesday, June 17, 1835. |
|---|---|---|---|---|---|---|
| 1 | 5 | | West. | S. S. W. | ¼ | The first part a fresh breeze and cloudy; the middle and latter clear weather, and less wind, with a heavy swell from the S. W., for which I allow 12 miles. |
| 2 | 5 | | | | | |
| 3 | 4 | 6 | | | | |
| 4 | 4 | 4 | | | | |
| 5 | 4 | 4 | | | | People employed pointing a new main-sail, and drawing and knotting yarns. |
| 6 | 4 | 2 | | | | |
| 7 | 4 | | | | | At 7h. 56m. P. M. the sun set W. 58° 50′ N. by compass, which makes the variation 22° 31′, or 2 points, West. |
| 8 | 4 | | | | | |
| 9 | 4 | | | | | |
| 10 | 4 | | | | | |
| 11 | 3 | 6 | | | ½ | Saw a stranger, under all sail, standing to the N. Eastward. |
| 12 | 3 | 6 | | | | |
| 1 | 3 | 4 | | | | |
| 2 | 3 | | | | | Pumped ship at 14 inches water. |
| 3 | 3 | | | | | |
| 4 | 3 | | | | | |
| 5 | 2 | | W. S. W. | South. | 1 | |
| 6 | 2 | | | | | At 5h. 40m. A. M. the mer. alt. of the moon's U. L. 31° 38′ 15″ S., which places the ship in latitude 47° 52′ 27″ N. |
| 7 | 2 | 2 | | | | |
| 8 | 2 | 4 | | | | |
| 9 | 2 | 6 | | | | |
| 10 | 2 | 4 | | | | |
| 11 | 3 | | | | | Obs. mer. alt. of ⊙'s L. L. 65° 28′ 40″ S.: hence the lat. by obs. is 47° 43′ 12″ N. |
| 12 | 3 | | | | | |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 74° W. | 75′ | 21′ S. | 72′ W. | 47° 43′ | 47° 43′ | 108′ W. | 9° 19′ | ☽ Chr. | Cape Finisterre, South, 287m. |

This day the swell setting from the S. W. is supposed to drive the ship 12 miles to the N. E., which, corrected for variation, is N. N. E.; these are therefore set down as the *last course* and *distance* in the Traverse Table.

| True Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| W. S. W. ½ W. | 44 | | 14. 8 | | 41. 4 |
| W. S. W. ¼ W. | 20 | | 5. 8 | | 19. 1 |
| S. W. by W. | 20 | | 11. 1 | | 16. 6 |
| N. N. E. Swell. | 12 | 11. 1 | | 4. 6 | |
| | | 11. 1 | 31. 7 | 4. 6 | 77. 1 |
| | | | 11. 1 | | 4. 6 |
| | | Diff. lat. | 20. 6 | Dep. | 72. 5 |

With the diff. of lat. 20′. 6, and the departure 72′. 5, the course is S. 74° W., and the distance 75 miles.

| | | | | | |
|---|---|---|---|---|---|
| Yesterday's lat... | 48° | 0′ N. | ... | 48° | 0′ N. |
| Diff. of lat. by acc. | | 21 S. | | | |
| Lat. in by acc.... | 47 | 48 N. | (Obs.) | 47 | 43 N. |
| Sum of latitudes ..... | | 95 | 49 | | |
| Mid. latitude ..... | | 47 | 54 | | |
| Co. mid. latitude..... | | 42 | 6 | | |

The co. mid. lat. 42° 6′, and the departure 72′. 5 give the diff. of long. 109′ or... 1° 48′ W.

| | | |
|---|---|---|
| Yesterday's longitude..... | 7 | 31 W. |
| Longitude in by account ..... | 9 | 19 W. |

The diff. of lat. made between noon and sunset, *viz.* 8′ S., subtracted from 48° 0′ N., the lat. at last noon, gives the lat. 47° 58′ N. at 7h. 56m. P. M., when the amplitude was taken.

The lat. 47° 52½′ N. at 5h. 40m. A. M., by the moon's mer. alt., being brought up to noon by the log, makes the lat. 47° 43½′ N.

NOTE.—The course being large, the diff. of long. is found by middle latitude in preference to Mercator's Sailing.

*To find the Bearing and Distance of Cape Finisterre.*

| | | | | | |
|---|---|---|---|---|---|
| Lat. of ship by obs... | 47° 43′ N. | ..... Mer. Parts... | 3266 | Longitude of ship ..... | 9° 19′ W. |
| Lat. of C. Finisterre | 42 56 N. | ..... Mer. Parts... | 2858 | Long. of C. Finisterre | 9 16 W. |
| Diff. of latitude..... | 4 47 = 287′ | Mer. diff. lat. | 408 | Diff. of longitude..... | 3′ |

Hence the true course is nearly South, the compass course S. S. W., and the dist. 287 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Thursday, June 18, 1835. |
|---|---|---|---|---|---|---|
| 1 | 3 | | West. | S. S. W. | 1 | |
| 2 | 3 | | | | | Mostly fresh breezes throughout, with cloudy |
| 3 | 3 | 2 | | | | weather, and rain at times. |
| 4 | 3 | 2 | | | | In 1st. reef of the topsails. |
| 5 | 4 | | | | | |
| 6 | 4 | | | | | |
| 7 | 4 | 4 | | | | Tacked ship. |
| 8 | 5 | | S. S. E. | S. W. | ½ | At 10h. 8m. P. M., the obs. alt. of the Polar |
| 9 | 5 | | | | | Star was 46° 13′ N., which gives the lati- |
| 10 | 5 | | | | | tude 47° 19′ N. |
| 11 | 5 | | S. by E. | S.W. by W. | | |
| 12 | 5 | 2 | | | | At 12h. the foot rope of the mizen topsail |
| 1 | 5 | 4 | | | | gave way; unbent it, and bent another. |
| 2 | 5 | 2 | | | | |
| 3 | 5 | | | | | |
| 4 | 5 | 4 | S. by W. | W. by S. | | At 9h. 26m. 14s. A. M. the alt. ⊙'s L. L. was |
| 5 | 5 | 6 | | | | 50° 38′ 30″, bearing by compass S. E.; and |
| 6 | 6 | | | | | at 11h. 24m. 34s. the alt. ⊙'s L. L. was |
| 7 | 6 | | | | | 65° 43′ 10″, which gives the lat. by double |
| 8 | 6 | 4 | | | | altitudes 46° 6′ N. |
| 9 | 7 | | | | | |
| 10 | 7 | 2 | | | | |
| 11 | 6 | | | | | |
| 12 | 6 | | | | | Variation 2 points West. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 7° E. | 92′ | 92′ S. | 12′ E. | 46°11′ | 46° 3′ | 18′ E. | 9° 1′ | ☽ Chr. | Cape Finisterre, S. ¼ W., 187m. |

| True Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| W. by S. | 25 | | 4.9 | | 24.5 |
| S. E. ½ E. | 15 | | 10.1 | 11.1 | |
| S. E. by S. | 26 | | 21.6 | 14.4 | |
| S. by E. | 56 | | 54.9 | 10.9 | |
| | Diff. lat. | | 91.5 | 36.4 | 24.5 |
| | | | | 24.5 | |
| | | | Dep. | 11.9 | |

The lat. by the Polar Star at 10h. 8m. P.M. being 47° 19′ N., and the ship having made by the log 76′.5 of southing to noon, give the lat. at that time 46° 3½′ N.

The diff. of latitude 91′.5, and dep. 11′.9, give the course S. 7° E. and the distance 92 miles.

Yesterday's lat. by obs. 47° 43′ N. Mer. Pts. 3305
Diff. of lat. by acc. 92′ or 1 32 S.

Lat. in by account ... 46 11 N.

Lat. in by obs..... 46 3 N. Mer. Pts. 3120

Mer. diff. of lat. by obs. ..... 146

The course 7°, and the mer. diff. of lat. by obs. 146′, give the diff. of long..... 0° 18′ E.
Yesterday's longitude..... 9 19 W.

Longitude in by account ..... 9 1 W.

The latitude by double altitudes, when the greater alt. was observed, is 46° 6′ N., which, corrected for the run of the ship to noon, places her in lat. 46° 3′ N. at that time.

*To find the Bearing and Distance of Cape Finisterre.*

Lat. of ship by obs.. 46° 3′ N. ..... Mer. Parts... 3120 Longitude of ship ..... 9° 1′ W.
Lat. of C. Finisterre 42 56 N. ..... Mer. Parts... 2858 Long. of C. Finisterre 9 16 W.

Diff. of latitude..... 3 7 = 187′ Mer. diff. lat. 262 Diff. of longitude..... 15′

Hence the true course is about S. ¼ W., the magnetic course S. S. W. ¼ W., and the distance 187 miles.

## Ship BRITANNIA from England towards Madeira.

| H. | K. | F. | Courses. | Winds. | Leeway. | Remarks, Friday, June 19, 1835. |
|---|---|---|---|---|---|---|
| 1 | 6 | | S. by W. | W. by S. | | Fresh breezes throughout, with fair weather and smooth water. |
| 2 | 7 | | | | | |
| 3 | 7 | | | | | People employed under the Boatswain.—Carpenter making a top-mast studding-sail boom. |
| 4 | 6 | 6 | | | | |
| 5 | 6 | | | | | |
| 6 | 6 | 4 | S. by E. | S.W. by W. | | Sail-maker making a quarter-deck awning. |
| 7 | 6 | 4 | | | | |
| 8 | 6 | 4 | | | | |
| 9 | 6 | 4 | | | | |
| 10 | 6 | 4 | | | | Tacked. At 10h. P. M. obs. alt. of the Polar Star was 43° 56′ N., which makes the latitude 45° 3′ N. |
| 11 | 6 | 6 | West. | South. | | |
| 12 | 7 | | | | | |
| 1 | 7 | | | | | |
| 2 | 7 | | | | | |
| 3 | 7 | 4 | | | | At 6h. 30m. A. M. the sun's azimuth by compass was S. 81° 10′ E., the alt. of its L. L. 19° 46′ 10″, and the lat. brought on by the log from 10h. P. M., 44° 39′ N., which give the variation 22° 39′ W. |
| 4 | 8 | | | | | |
| 5 | 8 | | | | | |
| 6 | 8 | | | | | |
| 7 | 7 | 4 | | | | Passed by a ship under American colours standing to the eastward. |
| 8 | 7 | 4 | | | | |
| 9 | 7 | 2 | W. by S. | | | Mer. alt. ⊙'s L. L. 68° 55′ 50″ S., hence the lat. by obs. 44° 19′ N. |
| 10 | 7 | 4 | | | | |
| 11 | 7 | | | S. by W. | | |
| 12 | 7 | | | | | |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S.33° W. | 124′ | 104′ S. | 67′.5 W. | 44° 19′ | 44° 19′ | 96′ W. | 10° 37′ | ☽ Chr. | Cape Finisterre S. 35° E. 101.5 m. |

| Magnetic Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. by W. | 33 | | 32.4 | | 6.4 |
| S. by E. | 32 | | 31.4 | 6.2 | |
| West. | 74 | | | | 74.0 |
| W. by S. | 29 | | 5.7 | | 28.4 |
| | Diff. lat. | | 69.5 | 6.2 | 108.8 |
| | | | | | 6.2 |
| | | | | Dep | 102.6 |

In this Traverse Table, the magnetic or compass courses are entered, which give the diff. of lat. 69′.5, and the departure 102′.6; corresponding to these are the magnetic course S. 56° W., and the distance 124 miles.

Magnetic or compass course, S. 56° W.
Variation by azimuth ..... 23 W.

True course .....S. 33 W.

Yesterday's lat. by obs. 46° 3′ N. Mer. Pts. 3120
Diff. of lat. 104m. or 1 44 S.

Lat. in by account ... 44 19 N. Mer. Pts. 2972

Sum of latitudes ..... 90 22 Mer. diff. lat. 148
Mid. latitude..... 45 11
Co. mid. latitude ..... 44 49, and the dep. 67′.5 gives the diff. of longitude 96 miles.

The true course S. 33° W., and the distance 124 miles, give the true diff. of latitude 104′.0, and the true dep. 67.5 miles.

The course S. 33° W., and the mer. diff. of latitude 148′, give the diff. of longitude 96m. or ..... 1° 36′ W.
Yesterday's longitude ..... 9 1 W.

Longitude in by account .....10° 37′ W.

*To find the Bearing and Distance of Cape Finisterre.*

Lat. of ship by obs.... 44° 19′ N.....Mer. Parts... 2972 Longitude of ship..... 10° 37′ W.
Lat. of C. Finisterre. 42 56 N.....Mer. Parts... 2858 Long. of C. Finisterre.. 9 16 W.

Diff. of latitude. .... 1 23 = 83′ Mer. diff. lat. 114 Diff. of longitude ..... 1 21 = 81′

Hence the true bearing of Cape Finisterre is S. 35° E., or S. 12¼° E. by compass, and the distance 101.5 miles.

SHIP BRITANNIA from ENGLAND towards [illegible]

| H. | K. | F. | Courses. | Winds. | Lee-way | Remarks, Saturday, June 20, 1835. |
|---|---|---|---|---|---|---|
| 1 | 6 | 6 | W. by S. | S. by W. | | Strong breezes, with rain, attended with hard squalls, thunder, and lightning. |
| 2 | 6 | 2 | | | | In 1st. reef of the topsails. |
| 3 | 6 | | | | | |
| 4 | 5 | | | | | |
| 5 | 5 | | | | | Tacked. |
| 6 | 5 | | S. E. by S. | S. W. by S. | 1 | Squally. In top-gallant sails. |
| 7 | 5 | | | | | In 2d. reef of the top-sails. |
| 8 | 4 | | | | | Down top-gallant yards. |
| 9 | 4 | | S. S. E. | S. W. | 1 | |
| 10 | 4 | | | | | |
| 11 | 3 | 6 | | | | Hard squalls. Handed the main-sail and mizen top-sail. |
| 12 | 3 | | | | | Close reefed, and handed the fore and main top-sails, and brought the ship to under a fore-sail, mizen, and main stay-sail. |
| 1 | – | | up S. by E. / off S E. by E. | | 5 | |
| 2 | – | | | | | |
| 3 | – | | up W. by S. / off N.W by W | Variable. | | Wore ship. |
| 4 | – | | | | 5 | |
| 5 | 3 | | W. by N. | S. W. by S. | 1½ | At daylight more moderate. Set the top-sails double reefed, and the main-sail. Up top-gallant yards. |
| 6 | 3 | | | | | |
| 7 | 4 | | | | | |
| 8 | 4 | 6 | West. | S. S. W. | 1½ | Fair weather. Out all reefs of the top-sails. Set the top-gallant sails. |
| 9 | 4 | 2 | | | | |
| 10 | 4 | | | | | |
| 11 | 4 | | | | | |
| 12 | 4 | | | | | |

Variation 2 points West.

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. W. | 41′ | 29′ S. | 29′ W. | 43° 50′ | | 40′ W. | 11° 17′ | ☽ Chr. | Cape Finisterre S. E. by E. ½ E. 105m. |

It appears by this day's log, that the ship has been lying-to from midnight to 4h. A. M.; therefore the middle points between those the ship comes up to and falls off to, corrected for leeway, as directed in page 303, together with the drift, which is here assumed at 1 knot an hour, are inserted in the Traverse Table as the fourth and fifth magnetic courses and distances.

| Magnetic Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| W. by S. | 29 | | 5.7 | | 28.4 |
| S. E. | 14 | | 9.9 | 9.9 | |
| S. E. by S. | 15 | | 12.5 | 8.3 | |
| East. | 2 | | | 2.0 | |
| N. N. W. | 2 | 1.9 | | | 0.8 |
| W. N. W. ½ N. | 10 | 4.7 | | | 8.8 |
| W. N. W. ½ W. | 21 | 6.1 | | | 20.1 |
| | | 12.7 | 28.1 | 20.2 | 58.1 |
| | | | 12.7 | | 20.2 |
| | Diff. lat. | | 15.4 | Dep. | 37.9 |

The diff. of lat. 15′.4, and dep. 37′.9, give the magnetic course 6 pts. or W. S. W., and the distance 41 miles.

The variation 2 pts. West, allowed on the magnetic course W. S. W., give the true course S. W., which, with the dist. 41 miles, give the true diff. of lat. 29′.0 S., and the true departure 29′.0 W.

| | | |
|---|---|---|
| Yesterday's lat..... | 44° 19′ N. | Mer. Parts. 2972 |
| Diff. lat. by acc..... | 29 S. | |
| Latitude in by acc. | 43 50 N. | Mer. Parts. 2932 |
| Sum of latitudes ... | 88 9 | |
| Mid. latitude ..... | 44 4 | Mer. diff. lat. 40 |
| Co. mid. latitude ... | 45 56 | |

The comp. of mid. lat. 45° 56′, and dep. 29′.0, or the course 4 pts., and mer. diff. of lat. 40′, give the diff. of long. 40′ W., which added to yesterday's long. 10° 37′ W., give the long. in by acc. 11° 17′ W.

*To find the Bearing and Distance of Cape Finisterre.*

| | | | |
|---|---|---|---|
| Latitude of ship ..... | 43° 50′ N. | Mer. Parts ... 2932 | Longitude of ship..... 11° 17′ W. |
| Lat. of C. Finisterre.. | 42 56 N. | Mer. Parts ... 2858 | Long. of C. Finisterre 9 16 W. |
| Diff. of latitude ..... | 54′ | Mer. diff. lat. 74 | Diff. of longitude ..... 2 1 = 121 |

Hence the true bearing of Cape Finisterre is S. E. by E. ½ E., or S. E. ½ S. by compass, and the distance 105 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Leeway. | Remarks, Sunday, June 21, 1835. |
|---|---|---|---|---|---|---|
| 1 | 4 | | West. | S. S. W. | 1¼ | Fair weather throughout. |
| 2 | 4 | | | | | |
| 3 | 4 | | | | | |
| 4 | 4 | | | | | |
| 5 | 4 | | | | | |
| 6 | 4 | 6 | W. by S. | S. by W. | 1 | At 6h. 10m. P. M. the ⊙'s azimuth by compass was N. 52°20′ W., the altitude of his L. L. 16° 40′ 20″, and the latitude 43° 46′ N.* which give the variation 21° 2′ W. |
| 7 | 5 | | | | | |
| 8 | 5 | 2 | | | | |
| 9 | 5 | | S. W. by W. | S. by E. | ½ | |
| 10 | 5 | | | | | At 10h. 22m. P. M. the mer. alt. of the star Antares was 20° 29′ 50″ S., which makes the latitude 43° 33′ 15″ N. |
| 11 | 5 | | | | | |
| 12 | 5 | | | | | |
| 1 | 5 | | | | | |
| 2 | 5 | | | | | |
| 3 | 5 | | | | | |
| 4 | 5 | 6 | S. W. | S. E. by S. | | |
| 5 | 5 | | | | | |
| 6 | 5 | | | | | |
| 7 | 4 | 4 | | | | A. M. Performed divine service, and mustered the ship's company. |
| 8 | 4 | | | | | |
| 9 | 4 | 2 | | | | |
| 10 | 4 | | | | | Mer. alt. ⊙'s L. L. 70° 38′ 27″ S.; hence the lat. at noon by obs. is 42° 37′ 50″ N. |
| 11 | 4 | 4 | | | | |
| 12 | 4 | | | | | |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 46° W. | 103′ | 72′ S. | 74′ W. | 42° 38′ | 42° 38′ | 103′ W. | 13° 0′ | ☽ Chr. | Porto Santo S. 15° W. 596m. |

| Magnetic Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| W. by N. ¼ N. | 20 | 4.9 | | | 19.4 |
| West. | 15 | | | | 15.0 |
| SW. b. W ½ W | 35 | | 16.5 | | 30.9 |
| S. W. | 41 | | 29.0 | | 29.0 |
| | | 4.9 | 45.5 | Dep. | 94.3 |
| | | | 4.9 | | |
| | | Diff. lat. | 40.6 | | |

* In working up the log from noon to 6h. 10m. P. M., the latitude, when the azimuth was taken, is found to be 43° 46′ N., and the longitude by account at that time 11° 51′ W., with which, the variation is found as above.

The diff. of lat. 40′.6 and the dep. 94′.3 give the magnetic course S. 67° W. and the distance 103 miles.

The variation 21° W. allowed on the magnetic course, give the true course S. 46° W., which with the distance 103 m., give the true diff. of lat. 71′.5, and true departure 74′.1.

Yester.'s lat. by acc. 43° 50′ N. Mer. Parts 2932
Diff. of lat. 71′.5 or 1 12 S.

Lat. in by account. 42 38 N. Mer. Parts 2833
Sum of latitudes... 86 28
Middle latitude ... 43 14 Mer. diff. lat. 99
Co. mid. latitude... 46 46

The co. mid lat. 46° 46′ with the dep. 74′.1, give the diff. of long. 101m., or the course 46°, and mer. diff. lat. 99′, give the diff. of long. 102′.5

Yesterday's long. by acc. ... 11° 17′ W.
Diff. of long. 102.5m. or 1 43 W.

Longitude in by account ... 13 0 W.

*To find the Bearing and Distance of Porto Santo.*

Lat. of ship by obs. 42° 38′ N. ..... Mer. Parts... 2833 Longitude of ship ... 18° 0′ W.
Lat. of Porto Santo 33 3 N. ..... Mer. Parts... 2103 Long. of Porto Santo 16 19 W.

Diff. of latitude..... 9 35 = 575′. Mer. diff. lat. 730 Diff. of longitude ... 3 19 = 199′.

The mer. diff. lat. 730′, and the diff. of long. 199′, give the true course S. 15° W.; this course, and the proper diff. of lat. 575, give the distance 596 miles. The course to be steered is therefore S. 30° W., or S. W. ½ S.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Monday, June 22, 1835. |
|---|---|---|---|---|---|---|
| 1 | 4 | | S. W. | S. E. | | Variable light breezes and calms, with hot sultry weather throughout. |
| 2 | 4 | | | | | |
| 3 | 3 | 6 | | | | People and tradesmen employed variously. |
| 4 | 3 | 2 | | | | |
| 5 | 3 | | | | | Tried the current, and found it setting N. E. by N. at the rate of ½ a mile per hour. |
| 6 | 2 | 4 | | | | |
| 7 | 2 | 4 | | Variable. | | |
| 8 | 3 | | | | | |
| 9 | 2 | | | | | At 12h. 31m. P. M. the mer. alt. of the star Lyra or Vega was 86° 26′ S., which gives the lat. 42° 16′ N. |
| 10 | 2 | | | | | |
| 11 | 2 | | | | | |
| 12 | 1 | | | | | |
| 1 | } | | | | | At 4h. 30m. A. M. the sun's amplitude by compass was E. 12° 14′ N. and the lat. 42° 16′ N. which give the variation 20° 19′ W. |
| 2 | | | | | | |
| 3 | | | | Calm. | | |
| 4 | | | | | | |
| 5 | | | | | | At 8h. A. M. observed as follows:— |
| 6 | } | | | | | Times by Chron. Obs. alt. Sun's L.L. |
| 7 | 1 | | S. W. by S. | N. E. by E. | | * 20h. 47m. 46s. 36° 38′ 30″ |
| 8 | 1 | 6 | | | | 48 50 47 40 |
| 9 | 2 | | | | | 49 52 56 30 |
| 10 | 2 | 4 | | E. by N. | | |
| 11 | 3 | | | | | Obs. mer. alt. ⊙'s L. L. 71° 13′ 10″ S.; hence |
| 12 | 3 | 6 | | | | the lat. at noon by obs. is 42° 3′ 12″ N. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 24° W. | 35′ | 32′ S. | 14′ W. | 42° 6′ | 42° 3′ | 21′ W. | 13° 21′ | ☽ Chr. 13° 3′ | Porto Santo, S. 16° W., 562m. |

By this day's log, it appears that the current set N. E. by N. by compass, and the drift was at the rate of half a mile per hour, making 12 miles in the 24 hours; these are therefore set down in the Traverse Table as a course and distance.

| Magnetic Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. W. | 33 | | 23.3 | | 23.3 |
| S. W. by S. | 14 | | 11.6 | | 7.8 |
| N. E. by N. Current | 12 | 10.0 | | 6.7 | |
| | | 10.0 | 34.9 | 6.7 | 31.1 |
| | | | 10.0 | | 6.7 |
| | Diff. lat. | | 24.9 | Dep. | 24.4 |

The diff. of lat. 24′. 9, and dep. 24′. 4, give the magnetic course S. 44° W. and the dist. 35 miles.

The variation 20° 19′ W. allowed on the magnetic course S. 44° W., gives the true course S. 23° 41′ W., which, with the distance 35 miles, gives the true diff. of lat. 32′. 0, and true departure 14′. 2.

| | | | | |
|---|---|---|---|---|
| Yester.'s lat. by obs. | 42° 38′ | N. | Mer. Parts | 2633 |
| Diff. of lat. by acc. | 32 | S. | | |
| Lat. in by acc..... | 42 6 | N. | | |
| Lat. in by obs..... | 42 3 | N. | Mer. Parts | 2786 |
| | | | Mer. diff. lat. by obs. | 47 |

The course 24°, and the mer. diff. of lat. by obs. 47′, give the diff. of long..... 0° 21′ W.

Yesterday's long. by acc. .....13 0 W.

Longitude in by account .....13 21 W.

* The chronometer was received on board June 9th, when it was 1m. 45s. slow for Greenwich mean time, and losing 2.5s. daily: the interval being nearly 13 days, gives the accumulated rate 32. 2s. The longitude by chron. at the time of the above observations is 13° 0′ W., and the diff. of long. to noon 3′ W. being added, places the ship in longitude 13° 3′ W.

*To find the Bearing and Distance of Porto Santo.*

| | | | |
|---|---|---|---|
| Lat. of ship by obs.... | 42° 3′ N. | .....Mer. Parts... | 2786 |
| Lat. of Porto Santo... | 33 3 N. | .....Mer. Parts... | 2103 |
| Longitude by chron. | 13° 3′ W. | | |
| Long. of Porto Santo | 16 19 W. | | |

Diff. of latitude..... 9 0 = 540′ Mer. diff. lat.. 683 Diff. of longitude .... 3 16 = 196

Hence the true course is S. 16° W., magnetic course S. 35° W., and distance 562 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Tuesday, June 23, 1835. |
|---|---|---|---|---|---|---|
| 1 | 4 | | S. S. W. ½ W. | E. by N. | | An increasing breeze throughout, with fair weather and smooth water. |
| 2 | 4 | 4 | | | | |
| 3 | 5 | | | | | |
| 4 | 5 | | | | | Stayed the masts, set the rigging up, and rattled it down, fore and aft. |
| 5 | 5 | | | | | |
| 6 | 5 | 2 | | | | |
| 7 | 5 | 6 | | Variable. | | At 2h. 54m. P. M. the observed dist. between the sun and moon was 39° 6′ 8″, the alt. of the ☉'s L. L. 49° 20′ 45″, and the alt. of the ☽'s U. L. 16° 36′ 15″ (no index errors), making the long. 12° 58′ W., which brought on to noon by the log, gives the longitude 13° 54′ W. |
| 8 | 6 | | | | | |
| 9 | 6 | | | | | |
| 10 | 6 | 4 | | S. E. by E. | | |
| 11 | 7 | | | | | |
| 12 | 7 | | | | | |
| 1 | 7 | | | | | |
| 2 | 7 | | | | | In 1st. reef of the topsails. |
| 3 | 7 | | | | | |
| 4 | 8 | | S. W. by W. | S. E. | | At 7h. 10m. A. M. observed as follows:— |
| 5 | 7 | | | | | |
| 6 | 7 | 4 | | | | Times by Chron. 20h. 2m. 41s. — Obs. alt. Sun's L. L. 27° 30′ 30″ |
| 7 | 7 | 6 | S. W. | S. E. ½ S. | | 3 32 — 38 20 |
| 8 | 7 | 2 | | | | 4 44 — 46 40 |
| 9 | 8 | | | | | which give the long. at noon 14° 2′ W. |
| 10 | 8 | | | | | Obs. mer. alt. of ☉'s L. L. 73° 39′ 47″ S.: |
| 11 | 7 | 4 | | | | which gives the lat. at noon 39° 36′ 10″ N. |
| 12 | 7 | 4 | | | | Variation 1¾ point West. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 17° W. | 153′ | 146′ S. | 46′ W. | 39° 37′ | 39° 36′ | 60′ W. | 14° 21′ | ☽ 13° 54′ Chr. 14 2 | Porto Santo S. 16½° W. 409m. |

The courses being this day corrected for variation with the corresponding distances, will be as in the Traverse Table.

| True Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. ½ W. | 88 | | 87. 0 | | 12. 9 |
| S. W. ¾ S. | 22 | | 17. 7 | | 13. 1 |
| S. S. W. ½ W. | 46 | | 41. 6 | | 19. 7 |
| | | Diff. lat. | 146. 3 | Dep. | 45. 7 |

The diff. of lat. 146′. 3, and departure 45′. 7, give the true course S. 17° W., and the distance 153 miles.

Yes lat. by obs. 42° 3′ N. — Mer. Parts... 2786
Diff. lat. 146′ or 2 26 S.

Lat. in by acc. 39 37 N. (obs.) 39° 36′ — M. Pts. 2591
Sum of lat. ... 81 40
Middle lat. ... 40 50 — Mer. diff. lat. 195
Co. mid. lat... 49 10

The lat. at 2h. 54m. P. M., brought on from the last obs. is 41° 50′ N. The mean time at the ship is found by the sun's altitude.

The diff. of lat. made good between 7h. 10m. A. M. and noon, is 34′ S., which being added to 39° 36′ N., the lat. by obs. at noon, give the lat. 40° 10′ N., when the sights were taken for finding the long. by chron.; these give the long. at that time 13° 41′ W., to which add the diff. of long. made to noon, *viz.* 21′ W., their sum 14° 2′ W., will be the long. at noon by chron.

The co. mid. latitude 49° 10′, and the dep. 45′. 7, give the diff. of longitude 60′. 5; or the course 17°, and the mer. diff. of lat. 195′, give the diff. of long. 60′, or..... 1° 0′ W.

Yesterday's long. by acc. ..... 13 21 W.

Longitude in by account ..... 14 21 W.

*To find the Bearing and Distance of Porto Santo,*

Lat. of ship by obs. 39° 36′ N..... Mer. Parts... 2591 — Long. of ship by lunar. 13° 54′ W.
Lat. of Porto Santo 33 3 N..... Mer. Parts... 2103 — Long. of Porto Santo... 16 19 W.

Diff. of latitude..... 6 33 = 393′ — Mer. diff. lat. 488 — Diff. of longitude ..... 2 25 = 145′

Hence the true bearing of Porto Santo is S. 16½° W., or S. by W. ½ W., and the distance 409 miles. The course by compass is S. W. ¾ S.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Wednesday, June 24, 1835. |
|---|---|---|---|---|---|---|
| 1 | 7 | 4 | S. W. | S. E. | | A fresh breeze throughout, with passing squalls, and rain at times: latter part fine clear weather. |
| 2 | 7 | 6 | | | | |
| 3 | 8 | | | | | |
| 4 | 8 | | | | | People and tradesmen employed as yesterday. Gunner painting the boats. |
| 5 | 8 | | | | | |
| 6 | 8 | | | | | At 6h. 30m. P. M. the sun's azimuth by compass was N. 50° 18′ W., and the alt. of its L. L. 11° 20′ 10″, which, with the latitude 38° 50′ N., give the variation 18° 42′ W. |
| 7 | 8 | | | | | |
| 8 | 8 | | | | | |
| 9 | 8 | | | | | |
| 10 | 8 | 4 | | S. E. by E. | | At 4h. 23m. A. M. the obs. dist. between the * Fomalhaut and ☽'s remote limb was 98° 39′ 10″, the *'s alt. 20° 10′ 20″, and alt. ☽'s L. L. 11° 50′ 40″, East of merid., making the long. 14° 56′, which brought to noon, gives the longitude 15° 32′ W. |
| 11 | 8 | 2 | | | | |
| 12 | 8 | | | | | |
| 1 | 7 | 4 | | | | |
| 2 | 7 | 4 | | S. E. | | |
| 3 | 7 | | | | | |
| 4 | 7 | | | | | |
| 5 | 7 | | | | | At 8h. 0m. A. M. observed as follows:— |
| 6 | 8 | | | | | Times by Chro. 21h. 0m. 24s. — Obs. alt. Sun's L. L. 37° 5′ 20″ |
| 7 | 8 | | | | | 1 36 — 17 40 |
| 8 | 8 | | S. W. ¼ W. | S. E. by S. | | 2 52 — 30 15 |
| 9 | 8 | | | | | |
| 10 | 7 | 6 | | | | which gives the long. at noon 15° 39′ 45″ W. |
| 11 | 7 | 4 | | | | Obs. mer. alt. ☉'s L. L. 76° 25′ 10″ S., which |
| 12 | 7 | | | | | gives the lat. by obs. at noon 36° 50′ N. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 27° W. | 186′ | 165′ S. | 85′ W. | 36° 51′ | 36° 50′ | 108′ W. | 16° 9′ | ☽ 15° 32′ Chr. 15 40 | Porto Santo S. 9½° W. 230m. |

The courses corrected for variation, per azimuth, to the nearest degree, with the corresponding distances, will be as under.

| True Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. 26° W. | 148 | | 133.0 | | 64.9 |
| S. 32 W. | 38 | | 32.2 | | 20.1 |
| | | Diff. lat. | 165.2 | Dep. | 85.0 |

The lat. by acc. when the sun's azimuth was observed at 6h. 30m. P. M. was 38° 50′ N. The lat. by acc. at 4h 23m. A. M. when the dist. was observed, was 37° 41′ N. and the long. by the lunar 14° 56′ W., which, brought to noon by the log, places the ship in long. 15° 32′ W.

NOTE. The star being too near the meridian when the distance was taken, the mean time at ship was found by the moon's altitude.

The diff. of latitude 165′. 2, and the departure 85′. 0, give the true course S. 27° W., and the distance 186 miles.

Yes. lat. by obs. 39° 36′ N. — 39° 36′ M. Pts. 2591
Diff. lat. 165′ or 2 45 S.

Lat. in by acc. 36 51 N. (obs) 36 50 M. Pts. 3280

Sum of lats..... 76 26 M. D. L. 211
Mid. latitude ... 38 13
Co. mid. latitude 51 47

The co. mid. lat. 51° 47′, and the dep. 85′ give the diff. of long. 108 m.; or the course 27°, and the mer. diff. of lat. 211′, give the diff. of long. 107. 6 miles, or ..... 1° 48′ W.

Yesterday's long. by acc.....14 21 W.

Longitude in by account.....16 9 W.

*To find the Bearing and Distance of Porto Santo.*

Lat. of ship by obs... 36° 50′ N. ..... Mer. Parts... 2380 — Long. of ship by lunar 15° 32′ W.
Lat. of Porto Santo 33 3 N. ..... Mer. Parts... 2103 — Long. of Porto Santo 16 19 W.

Diff. of latitude..... 3 47 = 227′ — Mer. diff. lat. 277 — Diff. of longitude..... 47′

Hence the true course to Porto Santo is S. 9½° W. or S. ¾ W., the magnetic course S. S. W. ½ W. nearly, and the distance 230 miles.

## Ship BRITANNIA from England towards Madeira.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Thursday, June 25, 1835. |
|---|---|---|---|---|---|---|
| 1 | 7 | 4 | S. W. | S. S. E. | | First part a fresh breeze; middle and latter more moderate, and smooth water. |
| 2 | 7 | | | | | |
| 3 | 7 | | | | | |
| 4 | 7 | | | | | |
| 5 | 6 | 6 | | | | |
| 6 | 6 | | | | | |
| 7 | 6 | | | | | At 7h. 14m. P. M. the sun set W. 46° 23′ N. by compass, which gives the variation 16° 53′ W. or 1½ point. |
| 8 | 5 | | | | | |
| 9 | 5 | | W. S. W. | South. | ½ | |
| 10 | 5 | | | | | |
| 11 | 5 | | | | | At 10h.6m. P.M. the mer. alt. *Antares, or α Scorpii, was 28° 5′ S., making the latitude 35° 57′ N. |
| 12 | 4 | 6 | S. E. by E. | S. by W. | 1 | |
| 1 | 4 | 6 | | | | |
| 2 | 5 | | | | | |
| 3 | 4 | 4 | | | | |
| 4 | 4 | | | | | At 9h. A. M. observed as follows:— |
| 5 | 4 | | | | | Times by Chron. Obs. alt. Sun's L.L. |
| 6 | 3 | | West. | S. S. W. | 1½ | 21h. 58m. 46s. 48° 10′ 45″ |
| 7 | 3 | | | | | 22 0 8 21 15 |
| 8 | 3 | | | | | 22 1 34 31 50 |
| 9 | 3 | 6 | | | | which give the long. at noon 16° 20′ W. |
| 10 | 3 | 2 | | | | |
| 11 | 3 | | | | | Obs. mer. alt. ⊙'s L. L. 77° 28′ 10″ S. gives |
| 12 | 3 | | | | | the lat. at noon 35° 45′ 51″ N. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 29° W. | 65′ | 57′ S. | 32′ W. | 35° 53′ | 35° 46′ | 44′ W. | 16° 53′ | ☽ 16° 12′ Chr. 16 20 | Porto Santo S. 2° W. 163m. |

The courses corrected for variation per amplitude at sun-set, and for leeway, with their corresponding distances, will be as under.

| True Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. S. W. ½ W. | 52 | | 45. 9 | | 24. 5 |
| S. W. by W. | 15 | | 8. 3 | | 12. 5 |
| E. ½ S. | 27 | | 2. 6 | 26. 9 | |
| West. | 22 | | | | 22. 0 |
| | Diff. lat. | | 56. 8 | 26. 9 | 59. 0 |
| | | | | | 26. 9 |
| | | | | Dep | 32. 1 |

The diff. of latitude 56′. 8, and dep. 32′. 1, give the course S. 29° W., and the distance 65 miles.

Yest. lat ... 36° 50′ N. 36° 50′ ...Mer. Pts. 2380
Diff. of lat. 0 57 S.

Lat. by acc. 35 53 N. (obs.) 35 46 ...Mer. Pts. 2301

Sum of latitudes..... 72 36 ...M. D. L. 79
Middle latitude ..... 36 18
Co. middle latitude... 53 42

The lat. at sun-set brought up by the log since last noon, is 36° 7′ N. At 9h. A. M. the lat. by acc. is 35° 46′ N., and the long. by chron. at that time 16° 9′ W., to which the long. made up to noon, 11′ W., being added, gives the long. by chron. at that time 16° 20′ W. The long. made by chron. since last noon is 40′ W.; this being added to the long. of yesterday by the lunar, which was 15° 32′ W., gives the long. brought on by chron. 16° 12′ W.

The co. mid. lat. 53° 42′, and the dep. 32′. 1, give the diff. of long. 40′; or the course 29°, and the mer. diff. lat. 79′, give the diff. of long. 43′. 6 W.: this being added to yesterday's long. by acc. 16° 9′ W., gives the long. by acc. this day, at noon, 16° 53′ W.

*To find the Bearing and Distance of Porto Santo.*

Lat. of ship by obs... 35° 46′ N.....Mer. Parts... 2301 Long. of ship by lunar... 16° 12′ W.
Lat. of Porto Santo. 33 3 N.....Mer. Parts... 2103 Long. of Porto Santo ... 16 19 W.

Diff. of latitude. .... 2 43 = 163′ Mer. diff. lat. 198 Diff. of longitude..... 7

Hence the true bearing is S. 2° W. or S. ¼ W. nearly, and the distance 163 miles. The course by compass is therefore S. 19° W. or S. by W. ¾ W. nearly.

**Ship BRITANNIA from England towards Madeira.**

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Friday, June 26, 1835. |
|---|---|---|---|---|---|---|
| 1 | 3 | | West. | S. S. W. | 1½ | An increasing breeze, and fair throughout. |
| 2 | 3 | | | | | |
| 3 | 4 | | | | | |
| 4 | 4 | 6 | S. W. by W. | S. by E. | 1 | P. M. bent the best bower and sheet cables, and unstowed the anchors. People otherwise employed, reeving the harbour-gear, and in sundry small jobs. |
| 5 | 5 | | | | | |
| 6 | 5 | | | | | |
| 7 | 5 | 4 | | | | |
| 8 | 6 | | South. | East. | | |
| 9 | 6 | | | | | At 8h. P. M. the alt. of the Polar Star was 34° 5′, which gives the lat. 35° 29′ N. |
| 10 | 6 | | | | | |
| 11 | 6 | | S. S. E. | | | |
| 12 | 6 | | | | | At 1h. 20m. A. M. the meridian alt. of the ✱ α Aquilæ or Altair, was 63° 33′ S., making the lat. 34° 58′ N. |
| 1 | 6 | 4 | | E. N. E. | | |
| 2 | 6 | 6 | | | | |
| 3 | 6 | 6 | | | | |
| 4 | 7 | | | | | At 8h. A. M. observed as follows:— |
| 5 | 7 | | | | | Times by Chron. — Obs. alt. Sun's L.L. |
| 6 | 7 | | | | | 21h. 1m. 50s. — 36° 40′ 45″ |
| 7 | 7 | | | N. E. by E. | | 2 58 — 48 20 |
| 8 | 7 | | | | | 4 7 — 55 45 |
| 9 | 7 | 4 | | | | which give long. at noon 15° 30′ 15″ W. |
| 10 | 8 | | | | | Obs. mer. alt. Sun's L. L. 79° 16′ 15″ S. gives |
| 11 | 8 | | | N. E. | | the lat. at noon 33° 56′ 2″ N. |
| 12 | 7 | 4 | | | | Variation 1½ point West. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| S. 21° ½ E. | 113′ | 106′ S. | 42′ E. | 34° 0′ | 33°56′ | 53′ E. | 16° 0′ | ☽ 15° 22′ Chr. 15° 30′ | Porto Santo S. W. ¼ S. 72m. |

| True Courses. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| West. | 10 | | | | 10.0 |
| S. W. ¼ W. | 20 | | 12.7 | | 15.5 |
| S. by E. ½ E. | 18 | | 17.2 | 5.2 | |
| S. E. ½ S. | 98 | | 75.7 | 62.2 | |
| | Diff. lat. | | 105.6 | 67.4 | 25.5 |
| | | | | 25.5 | |
| | | | Dep. | 41.9 | |

The diff. of lat. 105′.6, and dep. 41′.9, give the course S. 21½° E., and the distance 113 miles.

Yest. lat.... 35° 46′ N. — 35° 46′ M. Pts. 2301
Dif.lat. 106′ or 1 46 S.

Lat. by acc... 34 0 N. (obs.) 33 56 M. Pts. 2167

Sum of latitudes ..... 69 42 M.D.L. 134
Middle latitude..... 34 51
Co. middle latitude ... 55 9

The comp. of mid. latitude 55° 9′, and the departure 41′.9, give the diff. of long. 51′, or the course 21½°, and the mer. diff. of lat. 134′, give the diff. of longitude 52.9 miles.

Yesterday's long. by acc.... 16° 53′ W.
Diff. of long. by acc. ..... 53 E.

Longitude in by account ... 16 0 W.

Yest. long. by lunar, brought on 16° 12′ W.
Diff. of long. by chronometer..... 50 E.

Long. in by lunar brought on by chronometer..... 15 22 W.

*To find the Bearing and Distance of Porto Santo.*

Lat. of ship by obs... 33° 56′ N.....Mer. Parts ... 2167 — Long. of ship by lunar 15° 22′ W.
Lat. of Porto Santo... 33 3 N.....Mer. Parts ... 2103 — Long. of Porto Santo 16 19 W.

Diff. of latitude ..... 53 — Mer. diff. lat. 64 — Diff. of longitude ..... 57

Hence the true bearing is S. W. ¼ S., and the distance 72 miles. The course by compass is therefore S. W. by W. ¼ W.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

| H. | K. | F. | Courses. | Winds. | Lee-way. | Remarks, Saturday, June 27, 1835. |
|---|---|---|---|---|---|---|
| 1 | 7 | 2 | S. W. by S. | N. E. | | A pleasant breeze, and fair throughout. |
| 2 | 7 | | | | | P. M. bent the small bower cable, and un- |
| 3 | 6 | 4 | | | | stowed the anchor. |
| 4 | 6 | | | | | |
| 5 | 5 | 4 | S. W. by W. | E. N. E. | | |
| 6 | 5 | | | | | Saw the land bearing S. W. by S. |
| 7 | 5 | 2 | | | | |
| 8 | 5 | | | | | |
| 9 | 5 | 2 | | East. | | Porto Santo W. S. W. about 5 leagues. |
| 10 | | | | | | At 10 P. M. brought-to. Main top-sail to |
| 11 | | | | | | the mast. |
| 12 | | | Lying-to. | | | |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | W. S. W. | | | At daylight made sail. |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | Porto Santo N. W. by N. Deserters S. W. by S. |
| 7 | | | | | | East end of Madeira W. by S. |
| 8 | | | | | | At noon came to an anchor in Funchal Roads, |
| 9 | | | W. by S. | | | with the best bower, in 25 fathoms; mud |
| 10 | | | Various. | | | and sand; off shore ¼ of a mile; Loo |
| 11 | | | | | | Castle bearing N. N. W., and Fort Lorenzo |
| 12 | | | | | | E. N. E. |

| Course. | Dist. | Diff. lat. | Dep. | Latitude N. Acc. | Latitude N. Obs. | Diff. long. | Longitude W. Acc. | Longitude W. Obs. | Bearing and Distance at noon. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ☽ Chr. | |

The courses steered from noon to 9h. P. M., and the bearing of Porto Santo from the ship at that time, corrected for 1½ point West variation; also the distances run, and the estimated distance of the ship from the land, being entered in a Traverse Table, will give the diff. of latitude 55′. 4, and the departure 35′. 9.

From hence the latitude of Porto Santo, by the ship's reckoning, is found to be 33° 1′ N., and the longitude, carried on by chronometer from the last lunar observation, 16° 19′ W.; differing 2 miles in latitude, and 0 miles in longitude, from its position, as laid down in Table LVI.

The ship's track during the preceding voyage is laid down on the Mercator's Chart, according to the latitude and longitude each day at noon.

## ABSTRACT OF THE PRECEDING JOURNAL.

| Week Days. | Date. | Winds. | Courses. | Dist. | Lat. by Acc. | Lat. by Obs. | Longitude by Acc. | Long. by Lunars and Chron. | True Bearings and Distances at Noon. |
|---|---|---|---|---|---|---|---|---|---|
| Monday..... | 1835 June 15 | E. N. E. N. by W. | S. 37° W. | 81′ | 48° 53′ N. | | 6° 27′ W. | | |
| Tuesday..... | 16 | N. by W. S. S. W. | S. 42° W. | 64 | 48 6 | 48° 6′ N. | 7 31 | | C. Finisterre, S. 13½° W., 319 miles. |
| Wednesday.. | 17 | S. S. W. S. | S. 74° W. | 75 | 47 45 | 47 43 | 9 19 | | C. Finisterre, South, 287 miles. |
| Thursday ... | 18 | S. S. W. W. by S. | S. 7° E. | 92 | 46 11 | 46 3 | 9 1 | | C. Finisterre, S. ¼ W., 187 miles. |
| Friday ..... | 19 | West S. by W. | S. 33° W. | 124 | 44 19 | 44 19 | 10 37 | | C. Finisterre, S. 35° E., 101.5 miles. |
| Saturday .... | 20 | Variable. | S. W. | 41 | 43 50 | | 11 17 | | C. Finisterre, S. E. by E. ¼ E. 105 miles. |
| Sunday ..... | 21 | S. S. W. S. E. by S. | S. 46° W. | 103 | 42 38 | 42 38 | 13 0 | | Porto Santo, S. 15° W., 596 miles. |
| Monday..... | 22 | Variable. | S. 24° W. | 35 | 42 6 | 42 3 | 13 21 | ☽ Chr. 13° 3′ W. | Porto Santo, S. 16° W., 562 miles. |
| Tuesday..... | 23 | Variable. | S. 17° W. | 153 | 39 37 | 39 36 | 14 21 | ☽ 13 54 Chr. 14 2 | Porto Santo, S. 16½° W., 409 miles. |
| Wednesday.. | 24 | S. E. | S. 27° W. | 186 | 36 51 | 36 50 | 16 9 | ☽ 15 32 Chr. 15 40 | Porto Santo, S. 9½ W., 230 miles. |
| Thursday ... | 25 | S. S. E. S. S. W. | S. 29° W. | 65 | 35 53 | 35 46 | 16 53 | ☽ 16 12 Chr. 16 20 | Porto Santo, S. 2° W., 163 miles. |
| Friday ..... | 26 | S. S. W. N. Easterly. | S. 21½° E. | 113 | 34 0 | 33 56 | 16 0 | ☽ 15 22 Chr. 15 30 | Porto Santo, S. W. ¼ S., 72 miles. |
| Saturday .... | 27 | N. E. East. | | | | | | | Anchored in Funchal Roads. |

| H. | K. | F. | Courses. | Winds. | Lee-way. | Signals. | Remarks, &c. Monday, April 6, 1835. |
|---|---|---|---|---|---|---|---|
| | | | | | | | A. M. |
| 1 | 3 | 6 | N. W. | N. N. E. | ½ | | |
| 2 | 2 | 6 | | | | | First and middle parts light variable winds, and cloudy weather; latter part moderate and fair. |
| 3 | 2 | 6 | | | | | |
| 4 | 2 | | W. N. W. | North. | ¼ | | |
| 5 | 3 | 4 | | | | | |
| 6 | 5 | | N. by W. | Variable. | | | A. M. stayed the masts, set the rigging up, and rattled it down fore and aft. |
| 7 | 4 | 2 | | Light Airs. | | | |
| 8 | 1 | | | | | | |
| 9 | | 4 | | | | | At noon a strange sail in sight, bearing N. W. by W. |
| 10 | | | | Calm. | | | |
| 11 | | | | | | | |
| 12 | 1 | 4 | E. N. E. | West. | | | Variation 2 Points West. |

| Course. | Dist. | Latitude. | | Longitude. | | | Bearing and Dist. at Noon. |
|---|---|---|---|---|---|---|---|
| | | By D. R. | By Obs. | By D. R. | By Chr. | By L. Obs. | |
| N. 26° W. | 57′ | 48° 17′ N. | 48° 20′ N. | 9° 4′ W. | 9° 15′ W. | 9° 22′ W. | Lizard, N. E. by E. 191m. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | P. M. |
| 1 | 1 | 6 | E. by N. | West. | | | |
| 2 | 2 | 2 | | | | | |
| 3 | 3 | 4 | | | | | At 4h. P. M. a suspicious looking vessel in sight, right a-head. Made all possible sail in chase of her: then mustered the ship's company to their quarters, and prepared for action. |
| 4 | 3 | 6 | | | | | |
| 5 | 5 | 2 | | | | | |
| 6 | 5 | 4 | | | | | |
| 7 | 5 | 4 | E. by S. | W. N. W. | | | |
| 8 | 5 | 4 | | | | | |
| 9 | 5 | 4 | | | | | At midnight spoke the chase. She proved to be a Spanish brig from Teneriffe, bound to Corunna. |
| 10 | 6 | | | | | | |
| 11 | 6 | 2 | | | | | |
| 12 | 6 | 2 | | | | | |

| H. | K. | F. | Courses. | Winds. | Lee-way. | Signals. | Remarks, &c. Tuesday, April 7, 1835. |
|---|---|---|---|---|---|---|---|
| | | | | | | | A. M. |
| 1 | 6 | | E. by S. | W. N. W. | | | |
| 2 | 6 | | | | | | First part moderate breeze, and smooth water; middle and latter, light variable airs, with drizzling rain. |
| 3 | 5 | 4 | | | | | |
| 4 | 5 | 4 | | | | | |
| 5 | 5 | 4 | | | | | |
| 6 | 4 | 2 | | | | | |
| 7 | 4 | 2 | | | | | |
| 8 | 4 | | East. | N. W. | | | |
| 9 | 4 | | | | | | Exercised great guns and small arms. |
| 10 | 3 | 6 | | | | | |
| 11 | 3 | 2 | | | | | |
| 12 | 3 | | | Variable. | | | Variation 2 Points West. |

| Course. | Dist. | Latitude. | | Longitude. | | | Bearing and Dist. at Noon. |
|---|---|---|---|---|---|---|---|
| | | By D. R. | By Obs. | By D. R. | By Chr. | By L. Obs. | |
| N. 72½° E. | 110′ | 48° 53′ N. | 48° 55′ N. | 6° 24′ W. | 6° 33′ W. | 6° 40′ W. | Lizard, N. 43° E. 86m. |

SHIP ——— from ENGLAND towards CEYLON.

| H. | Courses. | K. | F. | Winds, &c. | Lee-way. | Friday, August 14, 1835. |
|---|---|---|---|---|---|---|
| 1 | S. W. | 2 | | S. S. E. | 1 | Moderate breezes, and pleasant weather throughout. |
| 2 | | 2 | 4 | | | A. M. stayed the masts, and set up the main and main-top-mast rigging. |
| 3 | | 3 | 2 | | | Tradesmen variously employed. |
| 4 | | 3 | 2 | | | |
| 5 | | 3 | 4 | | | |
| 6 | | 4 | | | | |
| 7 | | 2 | 4 | | | |
| 8 | | 3 | | | | |
| 9 | | 3 | | | | |
| 10 | | 3 | | | | |
| 11 | | 3 | | | | |
| 12 | | 3 | | | | |
| 1 | | 3 | 6 | | | |
| 2 | | 3 | 6 | | | |
| 3 | | 2 | | | | |
| 4 | | 2 | 6 | | | |
| 5 | W. S. W. | 3 | 6 | S. by E. | | |
| 6 | | 4 | | | | |
| 7 | | 3 | 6 | | | |
| 8 | | 3 | 6 | | | |
| 9 | | 2 | | | | Latitude observed 2° 0′ N. |
| 10 | | 2 | | | | |
| 11 | | 2 | | | | |
| 12 | | 2 | | | | |
| | Dist. per log. | 72m. | | 11 Inches in the Well. | | |

Course and dist. S. 50° W. 70m. | X Lat. { obs. 58 / acc. 46 } | X Lon. { acc. 54 / chr. 82 } | Lat. { obs. 2° 0 N. / acc. 2 12 N. } | Lon. { mde. in. 21° 41′ / ( chr. 20° 12′ W. } | var. { pm. am. 18° W.

Departure 54 | S. of acc. 12. | W. of acc. 28 | Barom. 29. 5 | Therm. 78°.

| H. | Courses. | K. | F. | Winds, &c. | Lee-way. | Saturday, August 15, 1835. |
|---|---|---|---|---|---|---|
| 1 | S. W. | 4 | | S. S. E. | ½ | A steady breeze, and fine weather throughout. |
| 2 | W. S. W. | 4 | 4 | | | A. M. set up the mizen-rigging. |
| 3 | | 4 | | | | Washed the gun-deck, and exercised great guns and small arms. |
| 4 | | 4 | | | | |
| 5 | S. W. | 4 | | | ½ | |
| 6 | | 4 | | | | |
| 7 | | 2 | 6 | | | Longitude per Sun and Moon at 11h. A. M., 22° 8′ W. of Greenwich. |
| 8 | | 2 | 4 | | | |
| 9 | | 2 | 2 | | | |
| 10 | | 2 | | | | |
| 11 | | 2 | 6 | | | |
| 12 | | 3 | | | | |
| 1 | | 3 | | | | |
| 2 | | 2 | 6 | | | |
| 3 | | 3 | | | | |
| 4 | | 3 | | | | |
| 5 | | 3 | | | | |
| 6 | W. S. W. | 3 | | South. | ½ | |
| 7 | | 4 | 6 | | | |
| 8 | | 4 | 6 | | | Latitude observed 0° 56′ N. |
| 9 | | 3 | 6 | | | |
| 10 | | 3 | 4 | | | A strong set to the westward. |
| 11 | S S. W. | 3 | 4 | S. E. | ½ | |
| 12 | | 3 | 2 | | | |
| | Dist. per log. | 82m. | | 10 Inches in the Well. | | |

Course and dist. S. 47° W. 79m. | X Lat. { obs. 54 / acc. 54 } | X Lon. { acc. 58 / ch. 113 } | Lat. { obs. 0° 56 N. / acc. 1 6 N. } | Lon. { mde. in. 22° 30′ } ( 22° 9′ W. / chr. 23 5 | var. { pm. am. 18° W.

Departure 58 | S. of acc. 10. | W. of acc. 55 | Barom. 29. 6. | Therm. 78°

# EXPLANATION AND USE

OF

# THE TABLES.

## TABLES I. AND II.

*Difference of Latitude and Departure for Points and Degrees.*

THESE Tables are of very extensive use in Navigation, affording an easy and expeditious method of solving all problems in right-angled plane trigonometry, and consequently applicable to the various sailings, but particularly useful in working a traverse, whence they obtain the name of *Traverse Tables.*

Table I. contains the difference of latitude and departure (in whole numbers and tenths), answering to distances not exceeding 300, and for courses to every quarter point of the compass. Table II. is of the same nature and extent; but for courses consisting of whole degrees. The courses are set down at the top of the pages when they do not exceed 4 points or 45 degrees, and at the bottom when they are greater than these quantities: the distances are regularly arranged in the columns marked *Dist.;* the first beginning at 1, and ending at 60; the second beginning at 61, and ending at 120, and so on to 300: corresponding to each of these distances, the difference of latitude and departure are set down in adjoining columns, marked *Lat.* and *Dep.:* but it must be carefully observed, that when the course is less than 4 points, or 45 degrees, these must be taken out as marked at the top, and when more, as noted at the bottom of the pages.

Now, the difference of latitude and departure, answering to any given course and distance, being found opposite the distance in that page of the table which contains the course; if, therefore, any two of the four parts, *viz.* the course, distance, difference of latitude, and departure, be given, and those two be found together in the tables, the other two parts will be found in their respective places on the same page. In like manner, the parts of any right-angled plane triangle may be found (provided two of them, exclusive of the right angle, be given), by taking out the hypothenuse as a *Distance,* the perpendicular in a *Lat.* column, the base in the *Dep.* column, and the angle opposite to it as a course. Hence, when these tables are applied in parallel or middle latitude sailing, the co. lat. or co. mid. lat. is taken as a course, the departure or meridional distance is found in the *Dep.* column, and the difference of longitude in the *Dist.* column: in Mercator's sailing, the meridional difference of latitude is taken out in the *Lat.* column, and difference of longitude in the *Dep.* column.

When any of the given parts (excepting the course, which is never to be multiplied or divided) exceed the limits of the table, any aliquot part, as a half, third, fourth, &c. is to be taken; and those found corresponding are to be doubled, trebled, &c., that is, multiplied by the same figure that the given number is divided by.

## TABLE III.

### *Meridional Parts.*

This table is used in resolving problems by Mercator's sailing, and in constructing charts on Mercator's projection. The meridional parts are to be taken out for the degrees answering to the given latitude at the top or bottom, and for the minutes at either side column. Thus, the meridional parts corresponding to the latitude 49° 57′ are 3470.

## TABLE III*.

### *To correct the mean Refraction.*

The refractions contained in Table IV. being adapted to a mean state of the atmosphere, that is, when the thermometer stands at 50°, and the barometer at 29. 6 inches, if it deviate from this weight and temperature, and accuracy be required, it will be necessary, especially in low altitudes, to correct the mean refraction by the seconds contained in this table, which are to be taken out with the apparent altitude in the side column, and the heights of the thermometer and barometer at the top and bottom, to be added or subtracted as expressed at the top or bottom of the respective columns.

EXAMPLE. Let the apparent altitude be 5°, the height of the thermometer 74°, and that of the barometer 30. 0 inches: required the true refraction.

| | | | |
|---|---|---|---|
| Mean refraction by Table IV. to 5° altitude ..... | | 9′ | 54″ |
| Correction for altitude 5°, and 74° height of thermometer... | − 33″ | | |
| Ditto for altitude 5°, and 30.0 height of barometer ... | + 9 | − | 24 |
| True refraction required ..... | | 9 | 30 |

## TABLE IV.

### *Mean Refraction.*

This table contains the refraction of the heavenly bodies, in minutes and seconds, at a mean state of the atmosphere, and corresponding to their apparent altitudes. This correction is always to be subtracted from the apparent altitude of the object. *Example.* The mean refraction for the apparent altitude 10° 50′, is 4′ 51″.

## TABLE V.

### *Depression, or Dip of the Horizon.*

This correction arises from the elevation of the observer above the surface of the sea, whereby the visible horizon, or that seen by the observer, is below the true; and, consequently, altitudes taken with the quadrant are too great by a quantity to be taken out from this table, opposite the height of the observer's eye in feet, and to be subtracted from altitudes taken by a fore observation, but added to those taken by a back one. *Example.* The dip for 20 feet is 4′ 17″.

## TABLE VI.

### *The Sun's Parallax in Altitude.*

This correction is to be taken out opposite the sun's altitude, and is always additive. *Example.* The sun's parallax corresponding to 50° of altitude, is 6″.

## TABLE VII.

*The Moon's Augmentation.*

The moon's apparent horizontal semidiameter, as given in the Nautical Almanac, is to be increased by a number of seconds, called the augmentation, taken out from this table, answering nearest to his altitude, in order to give the true apparent semidiameter.

## TABLE VIII.

*Dip of the Sea at different Distances from the Observer.*

When that part of the horizon immediately under the sun is obstructed by land, and the observer is nearer the shore than five or six miles, then, if the object be brought down to the line separating the sea and land, the dip will exceed that shewn in Table V., which is calculated for an open and unobstructed horizon, and will increase as the distance from the land diminishes. In this case, the dip is to be taken from the present table, with the height of the eye at the top, and the distance estimated in miles in the side column.

## TABLE IX.

*To correct the observed Altitude of the Sun's lower limb.*

This table is intended to simplify the usual method of correcting the observed altitude of the sun's lower limb, when taken by a fore observation, by shewing the correction at once for the joint effect of the sun's semidiameter, dip of the horizon, refraction, and parallax; and as it does not extend to altitudes less than 5°, the least altitude at which observations can be depended on for their accuracy, the corrections are always additive to the observed altitude of the sun's lower limb. These corrections being computed to minutes and tenths, the tenths may easily be reduced to seconds by multiplying them by six. In this table the sun's semidiameter is assumed at 16 minutes, and its variation from that quantity in each month of the year, given at the bottom of the table, is to be added to, or subtracted from, the correction found in the table, according as the sign + or − is prefixed to it.*

The simplicity of this table will appear sufficiently obvious in the following Examples.

EXAMPLE I. Suppose the observed altitude of the sun's lower limb, by a fore observation, to be 49° 57′ 30″, in the month of May, and the height of the eye 20 feet: required the true altitude of the sun's centre.

| | | | |
|---|---|---|---|
| Observed altitude of the sun's lower limb ..... | | 49° | 57′ 30″ |
| Correction to altitude 50°, and dip 20 feet ..... | 10′.9 | | |
| Ditto for variation of sun's semidiameter in May ... | −0.2 | | |
| | 10.7 = | + 10 | 42 |
| True altitude of the sun's centre ..... | | 50 | 8 12 |

* This table was computed by Mr. W. Galbraith, Teacher of Mathematics, at Edinburgh, who kindly presented it to the Author for insertion in the present Work.

EXAMPLE II. Let the observed altitude of the sun's lower limb, taken in the month of February, be 12° 32′ 15″, and the height of the eye 14 feet: required the true altitude of the sun's centre

| | | |
|---|---|---|
| Observed altitude of the sun's lower limb | | 12° 32′ 15″ |
| Correction to altitude 12° 30′ and dip 14 feet | 8′.2 | |
| Ditto for variation of sun's semidiameter in February | +0.2 | |
| | 8.4 | = + 8 24 |
| True altitude of the sun's centre | | 12 40 39 |

## TABLE X.

*Sun's Declination.*

The sun's declination is given in this table in degrees and minutes for the years 1834, 1835, 1836, and 1837, at noon on each day of the year under the meridian of Greenwich; but will answer for several subsequent years, by applying the corrections from Table XII. The table is to be entered with the year and month at the top, and the day in either side column; at the same time it is to be noted whether the declination be North or South, as expressed in each column.

## TABLE XI.

*To correct the Sun's Declination.*

As the sun's declination in Table X. is adapted to the meridian of Greenwich, when the ship is considerably to the eastward or westward of that meridian, it should be corrected by a number of minutes taken from this Table (placed at the bottom of the first and second pages of Table X.) with the declination at the top, and the nearest longitude in the side columns, to be added or subtracted, as directed at the head of the table.

EXAMPLE. Required the sun's declination at noon on September 18th, 1835, in longitude 108° West.

| | | |
|---|---|---|
| Sun's declination, from Table X. (decreasing) | 2° 4′ | North. |
| Correction for longitude 108°, Table XI., to be subtracted | − 7 | |
| Sun's true declination | 1 57 | North. |

## TABLE XII.

This table is intended to correct the sun's declination given in Table X. for the change that takes place in periods of four years. The table is to be entered with the period of years in either of the side columns, and the month and nearest day at the top; the minutes of correction there found, are to be added to, or subtracted from, the declination taken from Table X., answering to the number of years, reckoning in periods of four years, prior to that of the given year, as denoted at the head of the column; that is, the correction is to be added when the declination is increasing, or subtracted when decreasing.

EXAMPLE. Required the sun's declination at noon, on February 19th, 1849, at the meridian of Greenwich.

The year 1849 being a period of 12 years after 1837, find the declination in Table X. for the given day in the year 1837, which is 11° 14′ S.; then enter

Table XII under the month of February; opposite the period of 12 years, and under the 19th day of the month, will be found the correction 2′, which is to be subtracted from the above declination 11° 14′ S., and the remainder 11° 12′ S. will be the required declination.

## TABLE XIII.

*The right Ascensions and Declinations of the principal Fixed Stars*.*

This table contains the mean right ascensions and declinations of 61 of the principal stars, computed for the beginning of the year 1834, with their annual variations in seconds and decimal parts of a second. If their places are required for any time subsequent to the year 1834, the annual variation both in right ascension and declination must be multiplied by the number of years and parts of a year elapsed since that time, and the product will be the variation from the beginning of 1834 to the given time. This variation must always be added to the right ascension for 1834; but the variation in declination is additive or subtractive according as the sign + or − is prefixed to the annual variation; then the sum or remainder will be the right ascension and declination for subsequent years. But if the place of a star be required for any time preceding 1834, the variation in right ascension must be subtracted from that in the table, and the variation in declination applied contrary to the sign set against it.

EXAMPLE. Required the right ascension and declination of the Star Arcturus in June 1842.

From the beginning of 1834 to June 1842 there are about 8½ years.

| | | | | |
|---|---|---|---|---|
| Right ascension of Arcturus (in time) for January, 1834 ..... | 14h. | 8m. | 6s. | |
| Annual variation + 2s. 73, multiplied by 8½, gives 23s. 20, or ... | + | | 23 | |
| Right ascension of Arcturus for June 1842 ..... | 14 | 8 | 29 | |
| Declination of Arcturus for January, 1834 ..... | 20° | 3′ | 2″ | N. |
| Annual variation − 18″. 96, multiplied by 8½, gives 161″. 16, or | − | 2 | 41 | |
| Declination of Arcturus for June 1842..... | 20 | 0 | 21 | N. |

## TABLE XIV.

*The Sun's mean right Ascension.*

The sun's mean right ascension, contained in this table, is to be taken out with the month at the top, and the day in either side columns. It is sufficiently exact for ascertaining the time of an object's passing the meridian, in order to obtain the latitude by its meridian altitude; but when greater accuracy is necessary, recourse must be had to the Nautical Almanac.

---

* The Stars in the several Constellations being usually designated by Greek characters, we here give the alphabet, with the names of the letters.

| | | | | | |
|---|---|---|---|---|---|
| α Alpha. | ε Epsilon. | ι Iota. | ν Nu. | ρ Rho. | φ Phi. |
| β Beta. | ζ Zeta. | κ Kappa. | ξ Xi. | σ Sigma. | χ Chi. |
| γ Gamma. | η Eta. | λ Lambda. | ο Omicron. | τ Tau. | ψ Psi. |
| δ Delta. | θ Theta. | μ Mu. | π Pi. | υ Upsilon. | ω Omega. |

## TABLE XV.

*For correcting the observed Altitude of a fixed Star, to find the true Altitude.*

This table contains the correction in minutes and tenths to be subtracted from the observed altitude of a star, in order to obtain its true altitude; being the joint effect of refraction and dip of the horizon.

EXAMPLE. Required the true altitude of a star, whose observed altitude is 20° 30′; the height of the observer's eye being 24 feet.

| | | | |
|---|---|---|---|
| Star's observed altitude ..... | 20° | 30′ | 0″ |
| Correction opposite to altitude 20°, and under 24 feet, 7′.3 = | — | 7 | 18 |
| Star's true altitude ..... | 20 | 22 | 42 |

## TABLE XVI.

*For reducing the Time of the Moon's Passage over the Meridian of Greenwich, to the Time of its Passage over any other Meridian.*

The daily variation of the moon's passing the meridian is the excess of time above 24 hours that elapses till her return to the same; and this is found by taking the difference between her passing the meridian of Greenwich on a given day (from Page IV. of the month in the Nautical Almanac) and the preceding, if the longitude of the place be east, or that and the following, if the longitude be west.

Now as the moon is constantly advancing to the eastward in the heavens, she will therefore pass any meridian to the eastward of Greenwich sooner in the day, or a meridian to the westward later, than she does that of Greenwich, by a certain number of minutes, which is to the daily variation as the given longitude of the place is to 360°; and on this principle the table is constructed.

The table is to be entered with the daily variation to the nearest minute at the top, and the longitude of the place in the left side column; then the minutes corresponding to these being added to the time of the moon's passing the meridian of Greenwich, if the longitude be west, or subtracted if east, the sum or remainder will be the time of her passing the meridian of the place in mean time.

EXAMPLE. At what time will the moon pass the meridian of Calcutta, in longitude 88° 28′ E., on July 8th, 1835?

| | | |
|---|---|---|
| Mean time of the moon's passage over the meridian of Greenwich July 8th, by the Nautical Almanac ..... | 10h. | 46m. |
| Correction corresponding to daily variation 62m., and long. 88° 28′ E. | — | 15 |
| Time of moon's passing the meridian of Calcutta, July 8th ..... | 10 | 31 |

## TABLE XVI.*

*For finding the Time of High Water.*

This table is to be entered with the moon's semidiameter, (taken from Page III. of the month in the Nautical Almanac) or the nearest to it, at the top, and the time of the moon's passage over the meridian, in one of the columns so titled: the correction thus found, which is the effect of the sun's action, in accelerating or retarding the time of high water produced by the attraction of the moon, is to be applied to the time of the moon's passage over the meridian, according as the sign + or − is prefixed to it.

## TABLE XVII.

*For finding the Latitude by an Altitude of the Polar Star.*

This table is to be entered with the right ascension of the meridian at the time of observation; the correction corresponding to which being added to, or subtracted from, the true altitude of the Polar Star, as denoted by the sign + or −, the sum or remainder will give the latitude of the place of observation, which is always North.

The table is calculated particularly for the years 1835 and 1845, but will serve with tolerable accuracy for several subsequent years; the corrections may, however, be found for any other year, as follows: first reducing the right ascension and declination of the star, taken from Table XIII., to the given year.

Find the difference between the right ascension of the meridian and the star's right ascension: if the difference be more than 6 hours, and less than 12 hours, subtract it from 12 hours; if it be more than 12 hours, and less than 18 hours, subtract 12 hours from it; if more than 18 hours, subtract it from 24 hours; and the remainder, in each case, will be the star's distance from the meridian in time, which reduce to degrees by Table XIX. Find the number of degrees at the top or bottom of Table II., as if it were a course, and the complement of the declination, in minutes, as a distance: corresponding to these, in the difference of latitude column, will be the correction required in minutes; this correction added to the star's true altitude, if the difference between the star's right ascension and the right ascension of the meridian be more than 6 hours, and less than 18 hours, or otherwise subtracted, the result will be the latitude of the place of observation.

EXAMPLE. May 21, 1850, if the true altitude of the Polar Star be 50° 13′ at 10h. 15m. apparent time past noon, what will be the latitude of the place of observation?

The right ascension of the Polar Star, in May, 1850, will be 1h. 4m. 56s., and the declination 88° 30′ 45″ N.; consequently the complement of the declination 1° 29′ 15″, or 89 minutes.

| | 3h. | 51m. | |
|---|---|---|---|
| The sun's right ascension, May 21, (Table XIV.)† | | | |
| The time of observation | 10 | 15 | |
| Right ascension of the meridian | 14 | 6 | |
| Right ascension of the Polar Star | 1 | 5 | |
| Difference | 13 | 1 | |
| Subtract | 12 | 0 | |
| Polar Star's distance from the meridian | 1 | 1 | =15¼°. |

which taken as a course in Table II., and the co. declination 89′ as a distance, give in the lat. column 86 minutes, or 1° 26′, the correction, to be added to 50° 13′, the star's true altitude, because the above difference is between 6 and 18 hours: hence the latitude will be 51° 39′ N.

## TABLE XVII.*

Table XVII. being constructed on the principles of Plane Trigonometry, the latitude found by it requires a correction, especially in high latitudes, to be taken from this table, with the approximate latitude at the top, and the right ascension of the meridian in either side column. The corresponding minutes

† The sun's right ascension will be more correctly taken from the Nautical Almanac.

and tenths are always to be added to the approximate latitude deduced from the preceding table.

## TABLE XVIII.

*Corrections of the apparent Altitudes of the Sun and Stars.*

This table contains the correction to be applied to the apparent altitude of the sun or a star, in order to obtain the true altitude, and is also used in clearing distances from the effect of refraction and parallax; the sun's correction being the refraction in altitude diminished by parallax, and the star's correction its refraction only: these are to be taken out with the apparent altitude of the object.—*Example.* The sun's correction, corresponding to the apparent altitude 10° 28′, is 4′ 53″, and the star's correction for the same altitude is 5′ 1″.

## TABLE XIX.

*For reducing Longitude into Time, and the contrary.*

This table is intended to facilitate the reduction of degrees, &c. of longitude into time, or of hours, &c. into longitude. The method of using it will best appear by inspecting the following examples.

EXAMPLE I. Required the time answering to 42° 13′ 42″ of longitude.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Time answering to..... | 42° | 0′ | 0″ | is | 2h. | 48m. | 0s. | 0th. |
| Ditto to..... | 13 | 0 | ... | | | | 52 | 0 |
| Ditto to..... | | 42 | ... | | | | 2 | 48 |
| Hence the time answering to ..... | 42 | 13 | 42 | ... | 2 | 48 | 54 | 48 |

EXAMPLE II. Required the degrees, &c. corresponding to 7h. 6m. 48s.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Longitude corresponding to ..... | 7h. | 4m. | 0s. | is | 106° | 0′ | |
| Ditto to ..... | | 2 | 48 | ... | | 42 | |
| Hence the longitude corresponding to ..... | 7 | 6 | 48 | ... | 106 | 42 | |

Longitude in degrees, &c. may be converted into time, and the contrary, independent of this table, by the following Rules:—

1st. To convert degrees, &c. of longitude into time, multiply the longitude by 4, divide the degrees of the product by 60, and the quotient will be the hours, the remainder minutes, and the other parts of the product seconds, &c. of the corresponding time.

EXAMPLE. Required the time corresponding to 42° 13′ 42″ of longitude.

42° 13′ 42″
4

60 ) 168 54 48

2h. 48m. 54s. 48th.

2d. To convert time into degrees, &c. Reduce the hours and minutes into minutes, and divide by 4; then the quotient will be the degrees, minutes, &c. of the corresponding time.

EXAMPLE. Required the degrees, &c. corresponding to 7h. 6m. 48s. of time.

7h. 6m. 48s.
60

4 ) 426m. 48s.

106° 42′

## TABLE XX.

*For finding the Distance of terrestrial Objects at Sea.*

When the eye is elevated above the surface of the adjacent land or water, we not only see the surrounding objects more distinctly, but also see those which are more remote the higher we advance. Now, although the irregularity of the surface of the land will not admit of any one rule that will give the distance to which objects may be seen at different elevations, yet at sea, where the curvature of the water is uniform, those distances may be easily computed by means of this table, in which the distances are exhibited in nautical miles and decimal parts, answering to the height of the eye, or that of the given remote object, allowance having been made for terrestrial refraction.

EXAMPLE. Being at the mast head looking out for land, and elevated 130 feet above the surface of the sea, I discovered the top of a light-house in the horizon, whose height above the level of the sea is known to be 300 feet: required my distance from the light-house.

| | |
|---|---|
| In the table opposite 130 feet is ..... | 13.1 miles. |
| Ditto 300 feet is ..... | 19.9 |
| Sum gives the distance of the ship from the light-house ..... | 33.0 |

## TABLE XXI.

*For reducing the Sun's Declination to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.*

This table contains the corrections to be applied to the sun's declination as given in the Nautical Almanac, which is computed for apparent or mean noon at Greenwich, when it is required for noon at any other meridian, or to any given time at the meridian of Greenwich: it is to be entered with the declination for noon of the given day, as found in Page I. or II. of the Nautical Almanac, at the top, and the longitude of the place, or time at Greenwich, in the side columns; corresponding to these will be found the minutes and seconds to be applied to the above declination, by addition or subtraction, as directed at the head of the table; that is, when the declination is *increasing*, the correction is to be added in west longitude, but to be subtracted in east longitude, or to be added for Greenwich time; but when the declination is *decreasing*, the correction is to be subtracted in west longitude, but to be added in east longitude, or to be subtracted for Greenwich time.

When the declination and longitude, or time at Greenwich, are not nearly found in the table, proportional parts may be used.

When the given time at the meridian of Greenwich exceeds 12 hours, the correction must be taken out at twice, as in Example III.

It must be observed, that this table is subject to an error of a few seconds, from the sun's unequal motion in the ecliptic; but it is nevertheless in general sufficiently exact for observations taken at sea.*

EXAMPLE I. Required the sun's declination at apparent noon on Sept. 19th, 1835, in longitude 105° 15′ West.

| | | | |
|---|---|---|---|
| Sun's dec. at apparent noon, by Page I. N. A. (decreasing)... | 1° | 40′ | 15″ N. |
| Correction for longitude 105° 15′ W. ..... | — | 6 | 51 |
| Sun's declination when passing the meridian of the given place | 1 | 33 | 24 N. |

* When the sun's declination or right ascension is required to the nearest second, the proportional part of the daily variation may be readily found by logarithms. *See* Explanation and Use of Table XXXIII.

EXAMPLE II. Required the sun's declination on June 2d, 1835, at 4h. 24m. apparent time at Greenwich.

| | | | |
|---|---|---|---|
| Sun's dec. June 2, at app. noon, by Page I. N. A. (increasing) | 22° | 8′ | 18″ N. |
| Correction for 4h. 20m. apparent time | + | 1 | 34 |
| Sun's declination at Greenwich time | 22 | 9 | 52 N. |

EXAMPLE III. Required the sun's declination, Oct. 17th, 1835, at 15h. 36m. mean time at Greenwich.

| | | | |
|---|---|---|---|
| Sun's declination Oct. 17, at mean noon, by Page II. of the Nautical Almanac (increasing) | 9° | 5′ | 56″ S. |
| Correction for 12 hours..... + 10′ 58″ | | | |
| Ditto for 3h. 36m..... + 3 17 | + | 14 | 15 |
| Sun's declination at Greenwich time | 9 | 20 | 11 S. |

It will sometimes happen, when the sun is near the Equinoxes, that the correction for longitude, or Greenwich time, will exceed the declination; in this case, if the correction be subtractive, the declination is be taken from it, and the remainder will be the reduced declination, of a contrary name to that taken from the almanac.

EXAMPLE IV. What will be the sun's declination on September 23d, 1835, at 13h. 48m. mean time at Greenwich.

| | | | |
|---|---|---|---|
| Sun's declination, September 23d, at mean noon, by Page II. of the Nautical Almanac (decreasing) | 0° | 6′ | 40″ N. |
| Correction for 12 hours..... − 11′ 46″ | | | |
| Ditto for 1h. 48m..... − 1 46 | − | 13 | 32 |
| Sun's declination at Greenwich time | 0 | 6 | 52 S. |

## TABLE XXII.

*For reducing the Sun's right Ascension to any Time at the Meridian of Greenwich.*

By this table the sun's right ascension, taken out for noon of the given day, from Page I. or II. of the Nautical Almanac, according as the given time is apparent or mean, may be reduced to any given time at the meridian of Greenwich. It is to be entered with the right ascension at the top, and the Greenwich time in one of the side columns; the correction corresponding to the time being always *added* to the right ascension at the preceding noon: the sum will be the sun's right ascension at Greenwich time.

EXAMPLE I. Required the sun's right ascension, May 9th, 1835, at 5h. 36m. apparent time at Greenwich.

| | | | |
|---|---|---|---|
| Sun's right ascen. May 2, at app. noon, by Page I. of the N. A. | 3h. | 2m. | 33s. |
| Correction for 5h. 36m. | + | | 54 |
| Sun's right ascension at Greenwich time | 3 | 3 | 27 |

EXAMPLE II. What will be the sun's right ascension on October 10th, 1835, at 10h. 50m. mean time at Greenwich?

| | | | |
|---|---|---|---|
| Sun's right ascen. Oct. 10, at mean noon, by Page II. of the N. A. | 13h. | 0m. | 40s. |
| Correction for 10h. 50m. | + | 1 | 39 |
| Sun's right ascension at Greenwich time | 13 | 2 | 19 |

**Example III.** Required the sun's right ascension on July 13th, 1835, at 14h. 10m. mean time at Greenwich.

| | | | | | |
|---|---|---|---|---|---|
| Sun's right ascension, July 13th, at mean noon, by Page II. of the Nautical Almanac | | | | 7h. | 27m. 52s. |
| Correction for 12 hours..... | + | 2m. 1s. | ..... | + | 2 23 |
| Ditto 2h. 10m..... | + | 0 22 | | | |
| Sun's right ascension at Greenwich time | | | | 7 | 30 15 |

## TABLE XXIII.

*Logarithmic Sines, Tangents, and Secants, &c. to every Point and Quarter-Point of the Compass.*

This table is useful when the logarithmic sine, tangent, or secant of a ship's course is required to points, or quarter-points, of the compass: it is to be entered with the points in the left side column, when they do not exceed 4, and the names at the top; but when they are above that quantity, the points are to be taken from the right side column, and the names from the bottom.

EXAMPLES.

| | |
|---|---|
| The log. sine of 3 points is ..... | 9.744739 |
| The log. tangent of 6 points is ..... | 10.382776 |

## TABLE XXIV.

*Logarithms of Numbers.*

This table contains the decimal parts of the logarithms of numbers to six places of figures; but as in most of the calculations which occur in navigation, five places are sufficient, it must be observed, that when the sixth figure is omitted, if it be 5 or above, the preceding or fifth is to be increased by 1; thus the logarithm .966986, when taken out to five places only, will be .96699.

A logarithm consists of two parts, which are separated by a point; that on the left hand of the point is called the *index;* the figures on the right hand are the *decimal part;* and as it is the latter only that is inserted in the table, the index must be supplied according to the following rules:—

*The index of a logarithm is always one less than the number of figures in the whole number:* hence the index of 125 is 2, being one less than the number of figures contained in 125; also 2 is the index of 162.5; for although here are four figures, yet only three of them belong to the whole number, the .5 being a decimal figure. *If the natural number consist of decimal figures only, the index is 9 lessened by the number of ciphers before the first decimal figure:* thus the index of .0051 is 7, being 9 lessened by 2, the number of ciphers before the first decimal figure; the index of .00025 is 6, because there are three ciphers before the first decimal figure.

*To find the Logarithm of a natural Number.*

*If the number consist of one or two figures only.* Enter the first page of the table, and in one of the columns marked No. look for the given number; opposite to this, in the column marked Log., will be found the logarithm required, to which prefix the index according to the above directions: thus the logarithm of 56 is found to be 1.748188, the logarithm of 94 is 1.973128, and of .0025 is 7.397940.

*If the number consist of three figures.* Find the given number in the left-hand column of the table, and opposite, in the column marked 0 at the top or bottom, will be the logarithm required, to which prefix the index as before: thus the log. of 295 is 2.469822, of 1.76 is 0.245513, and of .0542 is 8.733999.

*When the number consists of four figures.* Look for the first three figures in the left side column (without attending to the decimal point, if there be any), and opposite to these, in the column marked with the fourth figure at the top or bottom, is the logarithm required: thus the logarithm of 1246 is 3.095518, of 17.95 is 1.254064, and of .2678 is 9.427811.

*If the number consist of five or more figures.* Find the logarithm of the first four figures, as before directed; then multiply the number found opposite in the right-hand column under *diff.* (which is the difference between two adjacent logarithms) by the remaining figures; point off from the product as many figures from the right as the multiplier consists of, and those remaining being added to the logarithm of the first four figures, the sum will be the logarithm required, to which prefix the index. If the figures pointed off to the right hand exceed a half, the unit figure of the remainder is to be increased by one.—*Example.* Required the logarithm of 25047. First look in the left side column for 250; opposite to this, in the column with 4 at the top, is the logarithm 398634, and in the right side column the diff. 173; this multiplied by 7, the fifth figure, gives 1211; from which cut off the last figure, and the remainder 121 added to 398634 will give, with the index prefixed, 4.398755, the logarithm required. In this manner the logarithm of 598765 will be found 5.777256.

*To find the natural Number corresponding to a given Logarithm.*

*If the number be required only to four figures.* Look in the table for the logarithm nearest to that given, opposite to which will be found the first three figures in the left side column, and the fourth figure at the top or bottom; the decimal point is then to be placed so that the whole number may contain *one figure more than that expressed by the index.* Suppose, for example, the natural number corresponding to the logarithm 2.326929 be required: the nearest logarithm to this is 326950, opposite to which is 212 in the left column, and 3 at the top, which, placed after the first three figures, and the decimal point fixed according to the index, will give 212.3, the natural number required.

*If the number be required to five or more figures.* Find the logarithm next less to the given one, which will give the first four figures; then take the difference between that and the given logarithm, to which annex as many ciphers as there are figures wanted above four; divide this by the difference found opposite the nearest less logarithm, and the quotient will be the remaining figures required.

For example—To find the natural number corresponding to the logarithm 4.478309 to five figures: the nearest less logarithm is 478278, answering to the number 3008, and the difference between that and the given logarithm is 31; to this annex a cipher, and divide by the difference 145, the quotient will be 2; therefore the number required is 30082. In the same way the natural number corresponding to the logarithm 5.497646 to six figures is 314518.

When the given logarithm consists of only five places of figures, add a cipher to the fifth figure, and proceed as before.

If the number required is to consist altogether of decimal figures, the same method must be used to obtain it as shewn above; only observe that 9 ciphers lessened by the value of the index are to be prefixed to the number found. Thus the number answering to the logarithm 7.819083 is .006593.

*To find the Arithmetical Complement of a Logarithm.*

The arithmetical complement of a logarithm is the number it wants of 10.000000 or 20.000000; and the easiest way to find it is, beginning at the left hand, to subtract every figure from 9, except the last significant figure, which is to be taken from 10; but if the index exceed 9, it is to be taken from 19. Thus the arithmetical complement of 4.478309 is 5.521691, and of 10.935547 is 9.064453: it is frequently used in the Rule of Proportion, and trigonometrical calculations, to change subtractions into additions.

Here follow a few examples to further illustrate the preceding rules.

| | Nat. Num. | | Logarithms. | | Logarithms. | | Nat. Num. |
|---|---|---|---|---|---|---|---|
| Given | 56 | to find | 1.748188 | Given | 1.369772 | to find | 23.43 |
| | 1.79 | ... | 0.252853 | | 2.456366 | ... | 286.0 |
| | 98.76 | ... | 1.994581 | | 3.567439 | ... | 3693.5 |
| | 596.84 | ... | 2.775858 | | 9.876542 | ... | .75256 |
| | .36875 | ... | 9.566732 | | 5.123562 | ... | 132911 |
| | 156795 | ... | 5.195333 | | 4.397625 | ... | 24981.9 |

## TABLE XXV.

*Logarithmic Sines, Tangents, and Secants.*

This table contains the logarithmic, or, as they are sometimes called, the artificial sines, tangents, and secants, to each degree and minute of the quadrant, with their complements or co-sines, co-tangents, and co-secants, to six places of figures, besides the index; but it may be observed, as of the last table, that five places being generally sufficient in the common practice of navigation, when the sixth is omitted, and it is 5 or above, the preceding or fifth figure is to be increased by a unit.

*To find the Logarithmic Sine, Co-sine, &c. of any given Arc in Degrees and Minutes.*

If the given degrees be under 45, they are to be taken from the top, and the minutes from the left side column; opposite to which, in that column with the name of the logarithm at top, will be found the required logarithm. But if the degrees be more than 45, they will be found at the bottom of the page, and the minutes in the right side column; likewise the name of the logarithm is to be taken from the bottom of the page.

When the given degrees exceed 90, they are to be subtracted from 180 degrees, and the logarithm of the remainder taken out, as before. Or the logarithmic sine, tangent, &c. of an arc more than 90 is the logarithmic co-sine, co-tangent, &c. of its excess above 90 degress.

EXAMPLES.

| | ° | ′ | | Log. to 6 places. | | Log. to 5 places. |
|---|---|---|---|---|---|---|
| Required the log. sine of ..... | 36 | 32 | ... | 9.774729 | ... | 9.77473 |
| co-sine of..... | 61 | 18 | ... | 9.681443 | ... | 9.68144 |
| tangent of ..... | 54 | 17 | ... | 10.143263 | ... | 10.14326 |
| co-tangent of ..... | 42 | 50 | ... | 10.032877 | ... | 10.03288 |
| secant of..... | 19 | 27 | ... | 10.025519 | ... | 10.02552 |
| co-secant of..... | 70 | 33 | ... | 10.025519 | ... | 10.02552 |
| sine of ..... | 108 | 36 | | | | |
| or sine of ..... | 71 | 24 | ... | 9.976702 | ... | 9.97670 |
| or co-sine of..... | 18 | 36 | | | | |

*To find the Arc in Degrees and Minutes nearest corresponding to a given Logarithmic Sine, Co-sine, &c.*

Look in the column marked at the top or bottom with the name of the given logarithm, and, when the nearest to it is found, the corresponding degrees and

minutes will be those required; observing that, when the name is at the top of the column, the degrees are to be taken from the top, and the minutes from the left side column; but if the name be at the bottom, the corresponding degrees will be there likewise, and the minutes in the right side column.

EXAMPLES. Required the arcs in degrees and minutes corresponding to the

| | | | |
|---|---|---|---|
| Log. sine..... | 9.265390 | ... | 10° 37′ |
| Co-sine ..... | 9.528461 | ... | 70 16 |
| Tangent ..... | 9.70156 | ... | 26 42 |
| Secant..... | 10.25413 | ... | 56 9 |

The arcs to logarithmic sines, &c. taken out to degrees and minutes only, are in general sufficiently accurate; but in some of the more rigid astronomical calculations, such as clearing the distance in lunar observations, rating chronometers, &c. it is frequently necessary to take them out to the nearest second: when this is the case, they are to be found in the following manner.

*To find the Logarithmic Sine, Tangent, Secant, &c. answering to an Arc of any given Number of Degrees, Minutes, and Seconds.*

Find the log. sine, &c. answering to the given degrees and minutes, as above, and take out from the proper column the difference of the adjacent logarithms to 100 seconds (marked at the top Diff. or D.); multiply this difference by the given seconds, and point off the two right-hand figures in the product; then those remaining being added to the log. sine, tangent, or secant of the given degrees and minutes, or subtracted from the log. co-sine, co-tangent, or co-secant, will give the logarithm required.

The differences to the sines and co-sines are set down on the right of their respective columns: the differences to the tangents and co-tangents, being the same, are placed between them; and the differences to the secants and co-secants, being the same as those to the co-sines and sines, are to be taken from the columns corresponding to the latter.

EXAMPLE I. Required the log. sine of 32° 21′ 45″.

| | |
|---|---|
| The logarithmic sine of 32° 21′ is..... | 9.728427 |
| The difference corresponding to the log. sine of the given degrees and minutes is 332; this multiplied by 45 (the number of seconds) pointing off two figures, is..... | + 149 |
| Sum is the log. sine required ..... | 9.728576 |

EXAMPLE II. Required the log. co-sine of 71° 40′ 25″.

| | |
|---|---|
| The logarithmic co-sine of 71° 40′ is ..... | 9.497682 |
| The difference corresponding to the log. co-sine of the given degrees and minutes is 666; this, multiplied by 25, gives ..... | − 159 |
| Remainder is the log. co-sine required..... | 9.497523 |

EXAMPLE III. Required the log. tangent of 56° 42′ 20″.

| | |
|---|---|
| The logarithmic tangent of 56° 42′ is ..... | 10.182516 |
| The corresponding difference 459, multiplied by 20, gives ..... | + 92 |
| Sum gives the log. tangent required ..... | 10.182608 |

EXAMPLE IV. Required the log. co-secant of 65° 18′ 23″.

| | |
|---|---|
| The logarithmic co-secant of 65° 18′ is ..... | 10.041671 |
| The difference corresponding to the sine of the given degrees and minutes is 97, which, multiplied by 23, gives ..... | − 22 |
| Remainder is the log. co-secant required..... | 10.041649 |

The logarithmic sines and tangents varying by great differences near the beginning and end of the quadrant, it has been thought proper, for the sake of accuracy, to give them for the first and second degrees to every 10 seconds, with their differences between the columns of sines and tangents: when, therefore, the log. sine or tangent of an arc less than 2 degrees be required to the nearest second, it is to be taken out to the next less tenth second, and the opposite difference multiplied by the unit seconds; then the product, cutting off one figure to the right, is to be added as before. As the sine and tangent of an arc is the co-sine and co-tangent of the complement of that arc, the latter may be found when above 88 degrees in a similar way, taking the degrees from the bottom, and the minutes and nearest less tenth second from the right side column, and observing to subtract the proportional part.

EXAMPLE V. Required the log sine of 1° 14′ 43″.

| | |
|---|---|
| The logarithmic sine of 1° 14′ 40″ is | 8.336819 |
| The corresponding diff. 968, multiplied by 3, gives | + 290 |
| Sum is the log. sine required | 8.337109 |

EXAMPLE VI. Required the log. co-sine of 89° 21′ 25″.

| | |
|---|---|
| The logarithmic co-sine of 89° 21′ 20″ is | 8.051054 |
| The corresponding diff. 1876, multiplied by 5, gives | − 938 |
| Remainder is the log. co-sine required | 8.050116 |

*To find the Degrees, Minutes, and Seconds of an Arc, answering to a given Logarithmic Sine, Co-sine, &c.*

Find the logarithm next less to the given one, if it be a sine, tangent, or secant, or next greater, if a co-sine, co-tangent, or co-secant, and note the corresponding degrees and minutes; then take the difference between the logarithm thus found and the given one, to which add two ciphers, and divide that number by the difference of 100″: the quotient will be the seconds to be annexed to the degrees and minutes before found.

EXAMPLE I Required the degrees, minutes, and seconds corresponding to the log. sine 9. 695476.

The log. sine next less to that given is 9. 695450, answering to 29° 44′; the difference between this logarithm and the given one is 26, which, with two ciphers added, makes 2600, and this divided by 368, the difference to 100″, gives the quotient 7″ to be annexed to 29° 44′: hence 29° 44′ 7″ are the required degrees, minutes, and seconds.

EXAMPLE II. Required the degrees, minutes, and seconds answering to the log. co-sine 9. 566797.

The log. co-sine next greater to that given is 9. 566951, to which answers 68° 21′; the difference between this logarithm and the given one is 154, which, with two ciphers added, makes 15400; this divided by 531, the difference to 100″, gives the quotient 29″ to be annexed to 68° 21′: hence 68° 21′ 29″ are the required degrees, minutes, and seconds.

But if the logarithm next less or greater than the given one should be found in the first six pages of the table, it will point out the degrees, minutes, and nearest less tenth second; then, to find the unit seconds, annex but one cipher to the difference found as before, and divide by the difference in the column marked Diff.

EXAMPLE. Required the degrees, minutes, and seconds answering to the log. sine 8. 421604.

Here the next less logarithm is 8. 421123, answering to 1° 30′ 40″: now the difference between this log. and the given one, with one cipher annexed, is 4810, which, divided by the difference 798, gives 6″; hence 1° 30′ 46″ are the degrees, &c. required.

## TABLE XXVI.

### *Natural Sines.*

In this table the natural sines are exhibited to every degree and minute of the quadrant, and arranged so that the degrees corresponding to the sines are to be taken from the top of the page, with their minutes in the left side columns; and the degrees answering to the co-sines, from the bottom, with their minutes in the right side columns: moreover, as they are given to six places of figures, the same rule with respect to the fifth figure must be observed when five only are required, as mentioned in the explanation of the two preceding tables.

The natural sine or co-sine of any number of degrees, &c. more than 90, is the same as the natural sine or co-sine of its supplement, found by subtracting them from 180°; or the natural sine or co-sine of an arc greater than 90°, is the natural co-sine or sine of its excess above 90°.

*To find the Natural Sine or Co-sine of a given Arc to any Number of Degrees, Minutes, and Seconds;*

*Or, to find the Degrees, Minutes, and Seconds of an Arc, corresponding to a given Natural Sine or Co-sine.*

These are to be found as directed for the logarithmic sines, &c., except that the differences to 100″ are to be taken from the bottom of that column containing the given degrees in the former case, or the nearest natural sine or co-sine in the latter.

EXAMPLE I. Required the natural sine of 32° 21′ 45″, or its supplement 147° 38′ 15″.

| | |
|---|---|
| The natural sine of 32° 21′ is | 535090 |
| The difference at the bottom of the column containing the natural sine of the given degrees and minutes is 409; this multiplied by 45, pointing off two figures in the product, gives | + 184 |
| Sum is the natural sine required | 535274 |

EXAMPLE II. Required the natural co-sine of 71° 40′ 25″, or 108° 19′ 35″.

| | |
|---|---|
| The natural co-sine of 71° 40′ is | 314545 |
| The difference 460, multiplied by 25, pointing off two figures, gives | — 115 |
| Remainder is the natural co-sine required | 314430 |

EXAMPLE III. Required the degrees, minutes, and seconds answering to the natural sine 495994.

The natural sine next less to that given is 495964, answering to 29° 44′; the difference between this natural sine and the given one is 30, to which two ciphers being added, and that divided by 422, the difference at the bottom of the column, gives the quotient 7″ to be annexed to 29° 44′: hence 29° 44′ 7″, or its supplement 150° 15′ 53″, are the degrees, &c. required.

EXAMPLE IV. Required the degrees, minutes, and seconds answering to the natural co-sine 368805.

The natural co-sine next greater to that given is 368936, to which answer 68° 21′; the difference between this natural sine and the given one is 131, to which two ciphers being added, and that divided by 451, the difference found at the bottom of the column, gives the quotient 29″. Hence 68° 21′ 29″, or its supplement 111° 38′ 31″, are the degrees, &c. required.

## TABLES XXVII. XXVIII. XXIX.

*Logarithmic Solar Tables.*

These tables are calculated expressly for the purpose of finding the latitude by two altitudes of the sun and the elapsed time; but the last is applied to several other problems in nautical astronomy.

These tables are to be entered with the hour at the top of the page, the minutes in the left-hand column, and nearest less fifth second at the top of the respective columns. The proportional parts for the remaining seconds are to be taken from the right-hand marginal columns, from those opposite to the logarithms taken from the body of the table: hence the time answering to the given logarithm, and the contrary, may be readily found to the nearest second, as will appear obvious by the following examples.

EXAMPLE I. Required the logarithm answering to the half-elapsed time 1h. 29m. 20s.

In Table XXVII., and in the page with 1 hour at the top, opposite 29 minutes, and in the column marked with 20ˢ at the top, will be found 0. 42022, the logarithm required.

EXAMPLE II. Required the log. half-elapsed time answering to 1h. 17m. 28s.

| | |
|---|---|
| The log. half-elapsed time (Table XXVII.) answering to 1h. 17m. 25s. is | 0.47964 |
| Proportional part for the remaining 3s., subtractive, because the logarithms are decreasing | − 27 |
| The log. half-elapsed time corresponding to 1h. 17m. 28s. | 0.47937 |

EXAMPLE III. Required the time answering to the log. middle time 4.92784.

| | |
|---|---|
| Log. middle time next less (Table XXVIII.) corresponding to 1h. 40m. 10s. is | 4.92765 |
| Given log. middle time | 4.92784 |
| Difference | 19 |

In the column of proportional parts opposite the nearest less log., the number 20 being the nearest to 19, the above difference, gives 3s.: hence the middle time required is 1h. 40m. 13s.

EXAMPLE IV. Required the log. rising of 2h. 55m. 43s.

| | |
|---|---|
| The log. rising of 2h. 55m. 40s. (Table XXIX.) is | 4.44662 |
| The proportional part for 3 seconds, found in the right-hand column nearly opposite the above log. is | + 23 |
| Hence the log. rising of 2h. 55m. 43s. | 4.44685 |

EXAMPLE V. Required the time corresponding to the log. rising 4. 73494.

| | |
|---|---|
| The given log. rising is | 4. 73494 |
| The log. rising next less, corresponding to 4h. 11m. 15s., is | 4. 73488 |
| Difference | 6 |

In the right-hand column, opposite the above log., the nearest proportional part is 5, which gives 1 second: this added to 4h. 11m. 15s., the time answering to the next less log., gives 4h. 11m. 16s., the time required.

It is necessary to notice, that the indices in these tables sometimes change in the columns where they could not be inserted, for want of room; this may, however, easily be known by observing that the first figure of the decimal part of the logarithms change from 9 to 0; for instance, the log. rising of 0h. 32m. 25s. is 2. 99942, but that of 0h. 32m. 30s. is 3. 00164. This change of the indices is also pointed out by both indices being shewn as a fraction in the left side column of the logarithms, as, in this instance, by $\frac{2}{3}$.

EXAMPLE VI. Required the log. rising of 1h. 43m. 24s

| | |
|---|---|
| The log. rising of 1h. 43m. 20s. is | 3. 99972 |
| The proportional part for 4 seconds, found in the right-hand column nearly opposite the above log., is | + 56 |
| Hence the log. rising of 1h. 43m. 24s. is | 4. 00028 |

In these tables, the logarithms for the first ten minutes of time varying by great differences, the proportional parts for the intermediate seconds could not be inserted: they must, therefore, if required, be found by the Rule of Proportion.

## TABLE XXX.

*Correction of the Moon's apparent Altitude.*

This table, which is placed on *left-hand* pages, contains the correction to be added to the moon's apparent altitude in order to obtain the true, being the parallax in altitude lessened by refraction, the former of which makes the moon appear lower, and the latter higher, than her true place: this correction is likewise used in reducing the moon's apparent distance from the sun, a star, or planet, to the true. The table is to be entered with the moon's apparent altitude to the nearest less tenth minute in the left side column, and the minutes of horizontal parallax at the top; the parts for the unit minutes of altitude may be found at the bottom of the first page, but are to be taken from the right-hand columns of the other pages, observing that when the altitude is less than 10 degrees, to take the parts out with the nearest less tenth minute of altitude at the side, and the unit minutes at the top, The parts answering to seconds of parallax are to be taken from the right-hand part of the table, entitled at the top " Add for Sec. of Par.", in that compartment where the first correction was taken, opposite the nearest less tenth second, and under the unit seconds. These parts are both additive.

EXAMPLE I. Required the correction corresponding to the moon's apparent altitude 33° 44′, and horizontal parallax 56′ 57″.

| | | |
|---|---|---|
| Correction for moon's altitude 33° 40′, and horizontal parallax 56′ | 45 | 1″ |
| Parts for 4′ of moon's altitude | + | 8 |
| Ditto for 57″ of horizontal parallax | + | 48 |
| Moon's correction required | 45 | 57 |

EXAMPLE II. Let the moon's apparent altitude be 8° 36′, and horizontal parallax 53′ 40″; required the corresponding correction.

| | | |
|---|---|---|
| Correction for moon's altitude 8° 30′, and horizontal parallax 53′ ..... | 46′ | 17″ |
| Parts for 6′ of moon's altitude..... | + | 3 |
| Ditto for 40″ of horizontal parallax ..... | + | 40 |
| Moon's correction required ..... | 47 | 0 |

EXAMPLE III. Required the moon's correction answering to the apparent altitude 64° 20′, and horizontal parallax 61′ 16″.

| | | |
|---|---|---|
| Correction for moon's altitude 64° 20′, and horizontal parallax 61′ ... | 25′ | 48″ |
| Parts for 0′ of moon's altitude ..... | + | 10 |
| Ditto for 16″ of horizontal parallax ..... | + | 7 |
| Moon's correction required..... | 26 | 5 |

The correction of the moon's apparent altitude may be found independent of this table, by adding together the log. secant of the apparent altitude (rejecting 10 in the index) and the proportional logarithm (XXXIV.) of the horizontal parallax; the sum of these will be the proportional logarithm of the parallax in altitude, from which subtract the refraction (taken from Table IV.) answering to the apparent altitude, and the remainder will be the moon's correction.

The first example will be thus worked:—

| | | | | |
|---|---|---|---|---|
| Moon's apparent altitude..... | 33° | 44′ ..... Secant..... | | 0.0801 |
| Moon's horizontal parallax ..... | 56′ | 57″ ..... Prop. Log. | | 0.4998 |
| Moon's parallax in altitude..... | 47′ | 22″ ..... Prop. Log. | | 0.5799 |
| Refraction (Table IV.)..... | 1 | 25 | | |
| Moon's correction..... | 45 | 57 | | |

## TABLE XXX.*

### *Auxiliary Arcs.*

This Table of Auxiliary Arcs is employed in finding the true distance by Method I.; and as it is arranged similar to Table XXX., it is placed on the *right-hand* pages, opposite to the same arguments as in that table.

The arcs are to be taken out with the moon's apparent altitude to the next less tenth minute in the left side column, opposite to which, in the column with the minutes of the moon's horizontal parallax at the top, will be found a corresponding arc in minutes and seconds, to which always prefix 60°; the parts for the unit minutes of the moon's apparent altitude are found at the bottom of the page, and for the seconds of parallax in the right-hand part of the table, similar to those in Table XXX. A correction for the sun or star's altitude is to be taken from the marginal column on the right hand; but when the distance of the moon from a planet is observed, the correction is to be taken from Table L. All these corrections are additive.

EXAMPLE I. Required the auxiliary arc corresponding to the moon's apparent altitude 33° 44′, the moon's horizontal parallax 56′ 57″, and the sun's apparent altitude 10°.

| | | | |
|---|---|---|---|
| Arc corresponding to alt. 33° 40′, and horizontal parallax 56′..... | 60° | 16′ | 59″ |
| Parts for 4′ of moon's altitude..... | | + | 2 |
| Ditto for 57″ of horizontal parallax ..... | | + | 19 |
| Ditto for sun's apparent altitude 10°..... | | + | 2 |
| Auxiliary arc required..... | 60 | 17 | 22 |

EXAMPLE II. Required the auxiliary arc corresponding to the moon's apparent altitude 8° 36′, the moon's horizontal parallax 53′ 40″, and a star's apparent altitude 10°.

| | | | |
|---|---|---|---|
| Arc corresponding to moon's alt. 8° 30′, and hor. parallax 58′ ... | 60° | 3′ | 37″ |
| Parts for 6′ of moon's altitude ..... | | + | 3 |
| Ditto for 40″ of horizontal parallax ..... | | + | 4 |
| Ditto for star's altitude 10° ..... | | + | 1 |
| Auxiliary arc required ..... | 60 | 3 | 45 |

EXAMPLE III. Required the auxiliary arc corresponding to the moon's apparent altitude 48° 37′, the moon's horizontal parallax 58′ 32″, a planet's apparent altitude 21°, and horizontal parallax 18″.

| | | | |
|---|---|---|---|
| Arc corresponding to moon's alt. 48° 30′, and hor. parallax 58′... | 60° | 24′ | 4″ |
| Parts for 7′ of moon's altitude ..... | | + | 3 |
| Ditto for 32″ of horizontal parallax ..... | | + | 14 |
| Ditto for planet's altitude 21°, and hor. parallax 18″ (Table L.)... | | + | 4 |
| Auxiliary arc required ..... | 60 | 24 | 25 |

## TABLES XXXI. XXXII.

*Logarithms for finding the Apparent Time or Horary Angle.*

The logarithms in these tables are intended to facilitate the computation of time, deduced from the altitude of a celestial object; they are arranged in the same manner as those in Tables XXVII., XXVIII, and XXIX., and therefore their corresponding times are to be found in the same manner as in those tables.

EXAMPLE. Required the time corresponding to the logarithm 9.24864.

| | |
|---|---|
| The given logarithm ..... | 9.24864 |
| The logarithm in the table next less to the above, corresponding to 3h. 19m. 10s. is ..... | 9.24850 |
| Difference ..... | 14 |

In the column of proportional parts opposite the nearest less logarithm, the difference 14 gives 2s.; therefore the time corresponding to the given logarithm is 3h. 19m. 12s.

## TABLE XXXIII.

*Logarithms for finding the Correction to reduce the Sun's Declination, Right Ascension, &c. to any Time under the Meridian of Greenwich.*

By this table the proportional part of the daily change of the sun's declination, right ascension, or any other elements that are given in the Nautical Almanac, for intervals of 24 hours, may be found to the nearest second. The numbers at the head of the columns may be considered either as hours, degrees, or minutes, and those in the side columns must be taken as minutes or seconds accordingly.

To find the proportional part corresponding to any given time at Greenwich, add together the logs. of the daily variation and of the Greenwich time; their sum will be the log. of the proportional part of the change in 24 hours, to be taken in the same manner as the daily change is found: this proportional part added to, or subtracted from, the declination, &c. at the preceding noon, according as it is increasing or decreasing, the result will be the declination, &c. at the given Greenwich time.

EXAMPLE I. Required the sun's declination and right ascension on Oct. 17, 1835, at 15h. 36m. mean time at Greenwich.

| | | | | | |
|---|---|---|---|---|---|
| Sun's declination, Oct. 17, by Page II. of Naut. Alm. | 9° | 5′ | 56″ | S. | |
| Ditto Oct. 18, by ditto ..... | 9 | 27 | 56 | S. | |
| Daily variation or change in 24 hours (increasing)..... | | 22 | 0 | .....Log. | 0378 |
| Greenwich mean time..... | | 15h. | 36m. | .....Log. | 1871 |
| Variation or change in 15h. 36m..... | +° | 14′ | 18″ | .....Log. | 2249 |
| Sun's declination, Oct. 17, by Page II. of Naut. Alm. | 9 | 5 | 56 | S. | |
| Ditto at Greenwich mean time..... | 9 | 20 | 14 | S. | |

| | | | | | |
|---|---|---|---|---|---|
| Sun's right ascension, Oct. 17, by Page II. of Naut. Al. | 13h. | 26m. | 37s. | | |
| Ditto, Oct. 18, by ditto ..... | 13 | 30 | 22 | | |
| Daily variation or change in 24 hours (increasing) ... | | 3 | 45 | ...Log. | 3062 |
| Greenwich mean time ..... | | 15h. | 36m. | ...Log. | 1871 |
| Variation or change in 15h. 36m..... | +h. | 2m. | 26s. | ...Log. | 2933 |
| Sun's right ascension, Oct. 17, by Page II. of Naut. Al. | 13 | 26 | 37 | | |
| Ditto at Greenwich mean time..... | 13 | 29 | 3 | | |

EXAMPLE II. Required the right ascension and declination of the Planet Venus, on March 31, 1835, at 11h. 48m. mean time at Greenwich.

| | | | | | |
|---|---|---|---|---|---|
| Venus's right ascen. March 31, by Page 281, Naut. Al. | 21h. | 50m. | 53s. | | |
| Ditto (March 32) April 1, by ditto ..... | 21 | 55 | 18 | | |
| Daily variation or change in 24 hours (increasing)..... | | 4 | 25 | ...Log. | 7351 |
| Greenwich mean time ..... | | 11h. | 48m. | ...Log. | 3083 |
| Variation or change in 11h. 48m..... | +h. | 2m. | 16s. | Log. | 1.0434 |
| Venus's right ascen. March 31, by Page 281, Naut. Al. | 21 | 50 | 53 | | |
| Ditto at Greenwich mean time..... | 21 | 53 | 3 | | |

| | | | | | |
|---|---|---|---|---|---|
| Venus's declination, March 31, by Page 281, Naut Al. | 12° | 48′ | 50″ | S. | |
| Ditto (March 32) April 1, by ditto ..... | 12 | 30 | 27 | S. | |
| Daily variation or change in 24 hours (decreasing) ... | | 18 | 23 | .....Log. | 1158 |
| Greenwich mean time..... | | 11h. | 48m. | .....Log. | 3083 |
| Variation or change in 11h. 48m..... | −° | 9′ | 2″ | .....Log. | 4241 |
| Venus's declination, March 31, by Page 281, Naut. Al. | 12 | 48 | 50 | S. | |
| Ditto at Greenwich mean time..... | 12 | 39 | 48 | S. | |

## TABLE XXXIV.

### *Proportional Logarithms.*

These logarithms were first calculated by Dr. Maskelyne, in order to facilitate the operation of finding the time at Greenwich, by comparing the observed distance between the moon and the sun, a star, or a planet, when reduced to the true, with those set down in the Nautical Almanac, for every third hour of Greenwich time; and are likewise frequently applied in other calculations where sexagesimals are concerned. The table is to be entered either with degrees

and minutes, or hours and minutes, at the top, and seconds in either side column. Thus the proportional logarithm of 0° 15′ 36″, or 0h. 15m. 36s. is 1.0621.

Proportion by logarithms being performed by adding together the arithmetical complement of the logarithm of the first term* to the logarithm of the second and third terms, rejecting 10 from the index; this table may therefore be readily applied in finding the fourth term of a proportion in sexagesimals; as we shall shew in the following examples.

EXAMPLE I. Suppose the sun's altitude to decrease 51′ in 16m. 23s. of time, how much will it decrease in 8m. 6s.?

| | | | |
|---|---|---|---|
| As | 16m. 23s. | Prop. Log. (Arith. Comp.) | 8.9591 |
| Is to | 8m. 6s. | Prop. Log. | 1.3468 |
| So is | 0° 51′ | Prop. Log. | .5477 |
| To decrease of alt. | 25′ 13″ | Prop. Log. | .8536 |

EXAMPLE II. Let the altitude of the moon's upper limb, observed at 3h. 28m. 44s. be 20° 3′, and 20° 45′ when taken at 3h. 38m. 20s.; required its altitude at 3h. 33m. 47s.

| | h. m. s. | | h. m. s. | | ° ′ |
|---|---|---|---|---|---|
| Time at first alt... | 3 28 44 | Time at first alt. | 3 28 44 | First alt. ... | 20 3 |
| Time at second alt. | 3 38 20 | Time at req. alt. | 3 33 47 | Second alt... | 20 45 |
| Diff..... | 9 36 | Diff..... | 5 3 | Diff.... | 0 42 |

| | | | |
|---|---|---|---|
| As | 9m. 36s. | Prop. Log. (Arith. Comp.) | 8.7270 |
| Is to | 5m. 3s. | Prop. Log. | 1.5520 |
| So is | 42′ 0″ | Prop. Log. | .6320 |
| To increase of alt. | + 22′ 6″ | Prop. Log. | .9110 |
| First observed alt. | 20 3 0 | | |
| | 20 25 6 | Altitude of moon's upper limb at 3h. 33m. 47s. | |

## TABLE XXXV.

*To correct the apparent Distance.*

This table contains a correction applied in reducing the apparent to the true distance by the approximate methods. It is to be entered with the distance at the top or bottom, and the moon's correction in altitude and in distance (or second correction) alternately, in the left side column; the difference between the numbers of seconds thus taken out, is to be added to the corrected distance when less than 90°, or subtracted when above.

EXAMPLE. Required the correction corresponding to the distance 70°, the moon's correction in altitude 36′, and the moon's correction in distance 13′.

In the column with 70° at the top, and opposite 36′ in the side column, is found 4″; again, in the same column, opposite 13′ in the side column, stands 1″; the difference of these two numbers of seconds, viz. 3″, is to be added to the corrected distance, because it is less than 90°.

This table is somewhat altered from the original when the distance is above 90° (the seconds being the complement to 20 of those formerly given), in order to adapt it to an easy and general method of clearing the distance, by Joseph

* The arithmetical complement of a proportional logarithm is found by subtracting it from 10.0000.

de Mendoza Rios, F. R. S. When his method is used, the seconds are to be taken out with the apparent distance at the top or bottom, and the moon's correction and difference of corrections in the side column.

## TABLE XXXVI.

### *Natural Versed and Suversed Sines.*

In this table, which is calculated to radius 1.000000, the degrees are given at the top of the pages from 0° to 89°, and from 90° to 180° at the bottom. To each degree there are three columns, marked versed, parts for ″, and *suvers.*; being abbreviations of natural versed sines, proportional parts for seconds of a degree, and supplementary natural versed sines, or suversed sines. In the left columns of the pages are the minutes of the arcs between 0° and 89°, beginning from the top; they also represent seconds in taking out the proportional parts of the versed sines. In the right columns of the pages are the minutes for arcs between 90° and 180°, beginning from the bottom; and they also represent seconds, in taking out proportional parts for suversed sines.*

*To find the Natural Versed Sine of a given Arc to the nearest Second.*

Find the natural versed sine, in the column of versed, corresponding to the given degrees and minutes, to which add the parts taken from the column of parts for ″, belonging to the given degree, opposite the seconds in the *left* column, and the sum will be the natural versed sine required. When the given arc exceeds 180°, it is to be subtracted from 360°, and the natural versed sine of the remainder will be that required.

EXAMPLE I. Required the natural versed sine of 65° 14′ 46″.

| | |
|---|---|
| Under 65° in column of versed, and opposite 14′ in the *left* column, is .... | .581076 |
| Under 65° in column of parts for ″, and opposite 46″ in the *left* column, is | 203 |
| Sum is the natural versed sine of 65° 14′ 46″ required..... | .581279 |

EXAMPLE II. Required the natural versed sine of 142° 38′ 39″, (or 217° 21′ 21″).

| | |
|---|---|
| Above 142° in column of versed, and opposite 38′ in *right* column, is ... | 1.794768 |
| Above 142° in column of parts for ″, and opposite 39″ in *left* column, is | 116 |
| Sum is the natural versed sine of 142° 38′ 39″ (or 217° 21′ 21″) required | 1.794884 |

*To find the Arc in Degrees, Minutes, and Seconds, corresponding to a given Natural Versed Sine.*

In one of the columns of versed find the natural versed sine next less to the given one, and the corresponding degrees and minutes will be those required. Subtract this natural versed sine from the given one, and opposite the remainder taken in the column of parts for ″, belonging to the degree already found, will be the seconds required in the *left* column.

EXAMPLE I. Required the arc in degrees, minutes, and seconds, corresponding to the natural versed sine 049925.

| | |
|---|---|
| The given natural versed sine is ..... | .049925 |
| The nearest less natural versed sine is found under 18°, and opposite 10′ in the left column, being ..... | .049846 |
| Difference ..... | 79 |

* This table is arranged similar to one in Mr. Riddle's Navigation, where only the last five decimal figures are inserted.

This difference 79 being found in the column of parts for ″, under 18°, corresponds to 51″ in the *left* column; therefore the arc required is 18° 10′ 51″.

EXAMPLE II. Required the arc to the nearest second corresponding to the natural versed sine 1.790977.

| | |
|---|---|
| The given natural versed sine is | 1.790977 |
| The nearest less natural versed sine is found above 142°, and opposite 16′ in the *right* column, being | 1.790868 |
| Difference | 109 |

The difference 110 being found in the column of parts for ″, above 142°, corresponds to 37″ in the *left* column: hence the required arc is 142° 16′ 37″.

This table is used in clearing the apparent distance of the moon from the sun, a star, or a planet, by Method I. in this Work, where only the *last five decimal figures* are taken out; but as the true distance never differs much more than a degree from the apparent distance, the figures omitted can never lead to error in discriminating to which degree the true distance belongs.

EXAMPLE. Suppose the apparent distance to be about 74°, and the true distance corresponding to the sum of the last five figures of the natural versed sines 15359 be required:

| | |
|---|---|
| The given sum of the five last figures of natural versed sines is | 15359 |
| Under 73°, in the column of versed, and opposite 27′ in the *left* column, is | 15148 |
| Difference | 211 |

The difference 210 in the column of parts for ″, under 73°, corresponds to 45″ in the left column; therefore the true distance would be 73° 27′ 45″.

The same figures would also correspond to the arc 102° 26′ 12″; but that cannot be the true distance, as it differs so many degrees from the apparent distance: hence no mistake can arise by employing only the last five figures.

*To find the Natural Suversed Sine of a given Arc to the nearest Second.*

Add 1 minute to the given arc, and take out the natural suversed sine of the degrees and minutes from the proper column; but the parts for seconds will be found opposite the given seconds in the *right* column, and are to be added to the natural suversed sine of the degrees and minutes.

EXAMPLE I. Required the natural suversed sine of 25° 19′ 12″.

| | |
|---|---|
| Under 25° in column of *suvers.*, and opposite 20′ in *left* column, is | 1.903834 |
| Under 25° in column of parts for ″, and opposite 12″ in *right* column, is | 101 |
| Sum is the natural suversed sine of 25° 19′ 12″ required | 1.903935 |

EXAMPLE II. Required the natural suversed sine of 164° 18′ 27″.

| | |
|---|---|
| Above 164° in column of *suvers.*, and opposite 19′ in *right* column, is | .037230 |
| Above 164° in column of parts for ″, and opposite 27″ in *right* column, is | 43 |
| Sum is the natural suversed sine of 164° 18′ 27″ required | .037273 |

## TABLE XXXVII.

*For reducing Sidereal to Mean Solar Time.*

This table is to be entered with the hours, minutes, and seconds of sidereal time, corresponding to which are the minutes, seconds, and hundredths of the acceleration of sidereal on mean time, the parts of which being taken out, and their sum subtracted from the given sidereal time, will convert the same into mean solar time.

EXAMPLE. Required the mean solar time corresponding to 8h. 25m. 42s. of sidereal time.

| | | | |
|---|---|---|---|
| 8h. of sidereal time gives ..... | | 1m. | 18.64s. |
| 20m. ..... | | | 3.28 |
| 5m. ..... | | | 0.82 |
| 40s. ..... | | | 0.11 |
| 2s. ..... | | | 0.01 |
| Acceleration of sidereal on mean time ... | — | 1 | 22.86 |
| Given sidereal time..... | 8h. | 25 | 42. |
| Mean solar time required ..... | 8 | 24 | 19.14 |

This table is useful when the time of a celestial object's transit over the meridian is noted by a sidereal clock, and it is required to find the corresponding mean time.

## TABLE XXXVIII.

*For reducing mean Solar Time to Sidereal Time.*

The minutes, seconds, and hundredths in the table are to be taken out in the same manner as those in the preceding table, and their parts added to the given mean time.

EXAMPLE. Required the sidereal time corresponding to the interval 2h. 42m. 50s. measured in mean solar time.

| | | | |
|---|---|---|---|
| 2h. of mean solar time give ..... | | 0m. | 19.71s. |
| 40m. ..... | | | 6.57 |
| 2m. ..... | | | 0.33 |
| 50s. ..... | | | 0.14 |
| Given mean solar time ..... | 2h. | 42 | 50 |
| Required sidereal time..... | 2 | 43 | 6.75 |

If double altitudes of a star be taken to determine the latitude, the elapsed time, measured by a chronometer or watch, is to be reduced to sidereal time, as above; then the computation will be the same as that for finding the latitude by double altitudes of the sun.

## TABLE XXXIX.

*Logarithmic Difference.*

The logarithms in this table are applied in several methods of reducing the apparent to the true distance. They are to be taken out with the given degree of the moon's apparent altitude at the top, and the nearest less tenth second of horizontal parallax in the left side column. The proportional part for the minutes of altitude, which is subtractive, is found by multiplying the difference to 100 minutes, taken out of the right side column opposite the horizontal parallax, by

the given minutes, and striking off two figures to the right; that answering to the unit seconds of parallax is found at the bottom part of the page under the given seconds, and is also subtractive. This logarithm is likewise to be further diminished by a number taken from Tables XL. or XLI. corresponding to the sun or star's apparent altitude; or from Table XLIX. when a planet is observed.

EXAMPLE I. Required the logarithmic difference corresponding to the moon's apparent altitude 65° 35′, the sun's apparent altitude 32° 59′, and the moon's horizontal parallax 57′ 20″. (*See* Example, p. 272.)

| | | |
|---|---|---|
| Log. difference to moon's apparent alt. 65°, and hor. par. 57′ 20″, is | | 9.993617 |
| The diff. 89 multiplied by 35′, gives the prop. part | — 31 | |
| Proportional part to 0″ of moon's horizontal parallax | — 0 | — 42 |
| Correction for sun's apparent altitude 33°, (Table XL.) | — 11 | |
| Logarithmic difference required | | 9.993575 |

EXAMPLE II. Required the logarithmic difference corresponding to the moon's apparent altitude 26° 23′, the star's apparent altitude 48° 16′, and the moon's horizontal parallax 56′ 30″. (*See* Example, p. 275.)

| | | |
|---|---|---|
| Log. difference to moon's apparent alt. 26°, and hor. par. 56′ 30″, is | | 9.997056 |
| The diff. 188 multiplied by 23′, gives the prop. part | — 43 | |
| Proportional part to 0″ of moon's horizontal parallax | — 0 | — 43 |
| Correction for star's apparent altitude 48° (Table XLI.) | — 0 | |
| Logarithmic difference required | | 9.997013 |

EXAMPLE III. Required the logarithmic difference corresponding to the moon's apparent altitude 71° 59′, a planet's apparent altitude 27° 7′, the moon's horizontal parallax 54′ 11″, and the planet's horizontal parallax 14″. (*See* Example, p. 279.)

| | | |
|---|---|---|
| Log. diff. to moon's apparent alt. 71°, and moon's hor. par. 54′ 10″, is | | 9.993716 |
| The diff. 68 multiplied by 59′, gives the prop. part | — 40 | |
| Proportional part to 1″ of moon's horizontal parallax | — 2 | — 56 |
| Corr. for planet's app. alt. 27°, and hor. par. 14″ (XLIX.) | — 14 | |
| Logarithmic difference required | | 9.993660 |

## TABLE XL. XLI.

### *To correct the Logarithmic Difference.*

These tables are intended to correct the logarithmic difference for the sun or a star's apparent altitude, with which they are to be entered, and the corresponding number subtracted from the logarithmic difference, as shewn above.

## TABLE XLII.

### *Amplitudes.*

This table is intended to expedite the method of finding the variation of the compass by comparing the magnetic with the true amplitude: the latter is here taken out by inspection, being given in degrees and minutes, and is to be found with the declination at the top, and the latitude in the left side column. Moreover, when the minutes of the latitude or declination are nearly 30, or half a degree, the mean of the amplitudes found for the two nearest degrees, will give the amplitude required nearly, as shewn in the following examples.

EXAMPLE I. What is the sun's true amplitude in latitude 51° 31′ N., when the declination is 8°?

| | | | |
|---|---|---|---|
| True amplitude by Table | for latitude 51° and declination 8° | ..... | 12° 47′ |
| Ditto | for latitude 52 and declination 8 | ..... | 13 4 |
| | | 2)25 | 51 |
| Sun's true amplitude required | | ..... | 12 55 |

EXAMPLE II. Required the sun's true amplitude in latitude 34° 5′, when the declination is 18° 32′.

| | | | |
|---|---|---|---|
| True amplitude by Table | for latitude 34° and declination 18° | ..... | 21° 53′ |
| Ditto | for latitude 34 and declination 19 | ..... | 23 7 |
| | | 2)45 | 0 |
| Sun's true amplitude required | | ..... | 22 30 |

EXAMPLE III. On what points of the horizon does the sun rise and set in latitude 57° 36′ N., when his declination is 18° 28′ S.?

| | | | |
|---|---|---|---|
| Sun's true amplitude | for latitude 57° and declination 18° | ..... | 34° 34′ |
| Ditto | for latitude 57 and declination 19 | ..... | 36 43 |
| Ditto | for latitude 58 and declination 18 | ..... | 35 40 |
| Ditto | for latitude 58 and declination 19 | ..... | 37 54 |
| | | 4)144 | 51 |
| Sun's true amplitude required | | ..... | 36 13 |

Hence the sun rises E. 36° 13′ S., or S. E. ¾ E., and sets W. 36° 13′ S, or S. W. ¾ W.

In the same manner the true amplitude of the moon, planets, or stars may be found when their declination and the latitude are given.

## TABLE XLIII.

*Semidiurnal and Seminocturnal Arches,*

*For finding the Time of the Rising and Setting of a Celestial Object.*

This table exhibits half the time that a celestial object continues above the horizon when the declination and latitude are of the same name; or below, when they are of contrary names; usually called its semidiurnal and seminocturnal arches, from whence the apparent time of its rising and setting may be computed. These are to be taken out with the latitude in either side column, and the declination at the top; then the angle of meeting will point out the arch required, which, if the object be the sun, will be the apparent time of its setting, when the latitude and declination are of the same name, or of its rising, when they are of contrary names; and this subtracted from 12 hours, will give the apparent time of the sun's rising in the former case, and of its setting in the latter: double the time of his rising will be the length of the night, and double the time of his setting, the length of the day.

EXAMPLE. Required the apparent time of the sun's rising and setting, with the length of the day and night, in latitude 51° 31′ N., when the declination is 20° N.

| | |
|---|---|
| The time answering to latitude 51° and declination 20° is ..... | 7h. 47m. |
| Ditto to latitude 52 and declination 20 is ..... | 7 51 |
| | 2)15 38 |
| App. time of the sun's setting, because lat. and declin. are both North | 7 49 |
| | 12 |
| Apparent time of the sun's rising ..... | 4 11 |
| Double the rising gives the length of the night in apparent time..... | 8 22 |
| Double the setting gives the length of the day in ditto ..... | 15 38 |

To find the apparent time of a star's rising and setting, subtract the sun's right ascension from the star's right ascension (increasing the star's right ascension by 24 hours, if it be less than the sun's), and the remainder will be the approximate time of the star's passing the meridian*; then the latitude and declination found in the table, will give the time the star takes in ascending from the horizon to the meridian, and descending from the meridian to the horizon, when they are of the same name: therefore, if these hours and minutes be subtracted from the time of its passage over the meridian, the remainder will be the apparent time of its rising; and, if added, the sum will be the time of its setting.

But when the latitude and declination are of contrary names, the time found as above will be half the star's continuance under the horizon; consequently it is to be subtracted from 12 hours, to give half the time of its continuance above the horizon; with which proceed as before.

EXAMPLE 1. At what apparent time does the Star Arcturus rise and set on June 1st, in latitude 51° North?

| | | |
|---|---|---|
| Star's right ascension by Table XIII. ..... | 14h. 8m. | |
| Sun's right ascension, June 1st, by Table XIV..... | 4 35 | |
| Approximate time of the star's passing the meridian..... | 9 33 | |
| Time answering to latitude 51° N., and star's declination 20° N., is | 7 47 | |
| Remainder gives the time of the star's rising ..... | 1 46 | |
| Sum gives the time of the star's setting ..... | 17 20 | P. M. |
| Or... | 5 20 | A. M. |

EXAMPLE II. At what apparent time does the Star Regulus rise and set on May 10th, in latitude 33° South?

| | | |
|---|---|---|
| Star's right ascension by Table XIII. ..... | 10h. 0m. | |
| Sun's right ascension, May 10th, by Table XIV. ..... | 3 8 | |
| Approximate time of the star's passing the meridian ..... ... | 6 52 | |
| Time answering to latitude 33° S., and star's declination 13° N., is 6h. 34m., which subtracted from 12 hours, is ..... | 5 26 | |
| Remainder gives the time of the star's rising ..... | 1 26 | |
| Sum gives the time of the star's setting ..... | 12 18 | P. M. |
| Or... | 0 18 | A. M. |

* The time of 60 of the principal stars passing the meridian throughout the year will be found in Table XLIV.

NOTE.—If the time of the sun or a star's rising or setting be required in mean time, the equation of time taken from the Nautical Almanac, must be applied to the apparent time, found as in the preceding Examples.

After the same manner, the mean time of the rising and setting of the planets may be computed, observing to take out their declination and passage over the meridian from pages 267 to 358 of the Nautical Almanac for 1835.

To find the time of the rising and setting of the moon, the time of her passage over the meridian of Greenwich in mean time is to be taken from Page IV. of the month in the Nautical Almanac, to which the minutes from Table XVI. are to be applied, in order to obtain the time of its passing the meridian of the given place; then the semidiurnal arch, found as before, answering to the moon's declination at the time of its passing the meridian (given in Pages V. to XII. of each month in the Nautical Almanac), and the latitude of the place, subtracted from the above reduced time, will give the approximate time of the moon's rising, or, added thereto, will give that of its setting. But as the moon changes her place in the heavens very rapidly, if greater accuracy be required, the declination must be taken from the Nautical Almanac corresponding to the approximate time of its rising or setting reduced to Greenwich time; then the semidiurnal arch being again found, and corrected by adding the minutes from Table XVI. corresponding thereto, and the daily variation of her passage over the meridian, the sum, subtracted from, or added to, the reduced passage over the meridian, will give the mean time of her rising or setting very nearly.

EXAMPLE. Required the mean time of the moon's rising at St. Helena, in latitude 15° 55′ S. and longitude 5° 43′ W., on July 8, 1835.

| | | | |
|---|---|---|---|
| In Page IV. of July in the Nautical Almanac, the time of the moon's passing the meridian of Greenwich is 10h. 46m., to which one minute (the number from Table XVI. answering to the daily variation 63m. and longitude 5° 43′) being added, gives the time of her passing the meridian of St. Helena ..... | 10h. 47m. | | |
| Time answering to latitude 16° S. and moon's declination 24½° S.... | 6 | 30 | |
| Remainder gives the approximate time of moon's rising ..... | 4 | 17 | |
| Longitude of St. Helena, in time (Table XIX.) ..... | 0 | 23 | W. |
| Corresponding Greenwich time ..... | 4 | 40 | |

The moon's declination at this time, by Page VI. of July in the Nautical Almanac, is 24° 47′ South.

| | | |
|---|---|---|
| Time answering to latitude 16° S., and declination 24° 47′ S. ..... | 6h. | 31m. |
| Correction from Table XVI. to 6h. 31m., and daily variation 63m.... | + | 17 |
| Semidiurnal arch corrected ..... | 6 | 48 |
| Reduced time of the moon's passing the meridian ..... | 10 | 47 |
| Time of the moon's rising ..... | 3 | 59 |

It must be understood that the above methods are only *approximations*, and may deviate two or three minutes from the truth; but it is presumed they will be found sufficiently exact for most nautical purposes.

The semidiurnal and seminocturnal arches may be found independent of this table, by adding together the log. tangents of the given latitude and declination, which sum will be the log. sine of an arch in degrees, &c. to be reduced into time, and increased by six hours.

## TABLE XLIV.

### *To find the Time of the principal Stars passing the Meridian.*

In this table the apparent times of 61 of the principal stars passing the meridian are given for every fifth day of each month throughout the year, beginning on the first day of each month; and since the stars perform a revolution, or return to the meridian, in 23 hours, 56 minutes, and 4 seconds of mean solar time, that is about 4 minutes earlier every day, when the time of their transit is required for any intermediate day, it may be found by multiplying the number of days, since the preceding one given in the table, by 4, and subtracting the product from the time of the transit on that day: the remainder will then be the apparent time of the transit on the day required. Suppose, for example, we want to know at what time the Star Aldebaran will pass the meridian on February 14th. Now, by the table it appears that the star will pass the meridian on the 11th of that month, at 6h. 46m.; then to find the time of its transit on the 14th, multiply 3, the number of days since the 11th, by 4; the product, 12 minutes, subtracted from 6h. 46m. will give 6h. 34m., the time of the star's passage over the meridian on the 14th February.

The times shewn in the table being only approximations, may deviate two or three minutes from the truth, but will nevertheless be sufficiently exact for the purposes to which they are intended to be applied.

By the assistance of this table, the method of finding the latitude by the meridian altitude of a star will be greatly facilitated; for when we know at what time nearly a star will pass the meridian, and its approximate altitude at that time, there can be no difficulty in making the requisite observation to determine the latitude: these opportunities occur frequently in the course of a clear night, and may be put in practice by any person otherwise unacquainted with the stars in the heavens; which we shall endeavour to explain by a few examples.

In the first place, the altitude of any star when passing the meridian, may be found by adding together the co-latitude of the place of observation, and the declination of the star, when they are of the same name, or taking their difference when of contrary names: the altitude to be reckoned from the South point of the horizon, when the latitude is North, and the contrary when South; but when the sum exceeds 90°, it is to be taken from 180°, and reckoned from the opposite point of the horizon, that is, from the North in North latitude, and from the South in South latitude.

Thus, having the time of the star's transit, or passage over the meridian, by the table, and its meridian altitude nearly by calculation, set the index of the quadrant to that altitude, and a few minutes before the time of the star's transit, direct the sight towards the North or South points of the horizon, as shewn above, and the reflected image of the star will be perceived in the horizon-glass, upon or near the horizon, which being brought into contact with it, and kept so until the star arrive at its greatest or meridian altitude, and the arch read off the quadrant, the correct latitude may be found by calculation.

Example I. Suppose, on the evening of July 6th, the ship being in latitude 36° 30′ N. by account, about nine o'clock, the latitude be required by observing the meridian altitude of a star. Now by the table, the Star Antares will pass the meridian on that day about 9h. 16m.; also by Table XIII. the declination of that star appears to be 26° 3′ S.; therefore from the complement of the latitude 53° 30′ N. subtract the star's declination, because they are of contrary names, and the remainder will give the meridian altitude 27° 27′, to which set the

index of the quadrant, and directing the sight to the South point of the horizon, observe the meridian altitude of the Star Antares, and thence deduce the latitude.

There is not the least danger of mistaking the star, as no other will have the same meridian altitude at that time.

EXAMPLE II. What star will be on the meridian about 5h. A. M. on February 3d, and what will be its meridian altitude, supposing the latitude of the ship to be 15° 40′ N. by account?

| | | | |
|---|---|---|---|
| By Table XLIV. the Star Arcturus will pass the meridian on February 1st at | 17h. | 6m. | |
| Number of days since 2 × 4 = | — | 8 | |
| Arcturus will pass the meridian on February 3d at | 16 | 58 | P. M. |
| | 12 | 0 | |
| Or... | 4 | 58 | A. M. |
| Latitude of the ship by account | 15° | 40′ | N. |
| | 90 | | |
| Complement of the latitude | 74 | 20 | N. |
| Declination of Arcturus by Table XIII. | 20 | 3 | N. |
| | 94 | 23 | |
| | 180 | | |
| Meridian altitude of Arcturus from the North point of the horizon | 85 | 37 | |

When the complement of a star's declination is less than the latitude, of the same name, the star will not rise or set, but pass the meridian below the pole 11h. 58m. after it has passed the meridian above the pole: its altitude being then observed, the latitude may thence be found by rules laid down for that purpose in page 189.

Its meridian, or least altitude at that time, is found by subtracting the complement of the declination from the latitude; which altitude is to be reckoned from the North or South points of the horizon according to the latitude.

EXAMPLE III. At what time will the Star Dubhe, in Ursa Major, be on the meridian below the pole on December 15th, and what will be its meridian altitude at that time in latitude 45° 40′ N.?

| | | | |
|---|---|---|---|
| Time of Dubhe's transit above the pole, Dec. 11th, Table XLIV. | 17h. | 37m. | |
| Number of days to December 14th, 3 × 4 = | — | 12 | |
| Time of Dubhe's transit above the pole, December 14th | 17 | 25 | |
| Half interval of the star's revolution | 11 | 58 | |
| | 29 | 23 | |
| | 24 | | |
| Time of Dubhe's transit below the pole, December 15th | 5 | 23 | P. M. |
| Declination of Dubhe by Table XIII. | 62° | 39′ | N. |
| | 90 | | |
| Complement of the declination | 27 | 21 | N. |
| Latitude | 45 | 40 | N. |
| Meridian altitude of Dubhe below the pole from the North point of the horizon | 18 | 19 | |

EXAMPLE IV. At what time will the Polar Star pass the meridian below the pole on March 6th, and what will be its meridian altitude in latitude 61° 30′ N.?

| | | |
|---|---|---|
| Time of the Polar Star's transit above the pole, March 6th (XLIV.) | 1h. | 50m. |
| Half interval of star's revolution | 11 | 58 |
| | 13 | 48 |
| | 12 | |
| Time of the Polar Star's transit below the pole, March 6th | 1 | 48 A. M. |
| Declination of the Polar Star by Table XIII. | 88° | 25′ |
| | 90 | |
| Complement of the declination | 1 | 35 |
| Latitude | 61 | 30 N. |
| Polar Star's meridian altitude below the pole from the North point of the horizon | 59 | 55 |

## TABLE XLV.

*For finding the Time most advantageous for observing the Altitude of a Celestial Object, in order to ascertain the Apparent Time.*

The most advantageous time for observing the altitude of a celestial object, from thence to deduce the apparent time at the meridian of a given place, is when the object is in the prime vertical; that is, when it bears true East or West from the observer,* or is at its nearest approach to those points:† this table is, therefore, intended to determine those times when the latitude and declination are both of the same name; for when they are of contrary names, the object is nearest those points when in the horizon; and in that case, the observation should be made when it is near the horizon, but not at a less altitude than 6 or 7 degrees, on account of the uncertainty of refraction at low altitudes.

The table is to be entered with the nearest degree of declination at the top, and degree of latitude at the side column, which will give the time from noon required, if the object be the *sun*; but if it be a *star*, proceed thus: find the time of the star's passage over the meridian on the given day by Table XLIV., and the time corresponding to the latitude of the place, and the declination of the star, from the present table; which subtracted from, or added to, the time of its transit over the meridian, according as the observation is to be made before or after its transit, the result will be the apparent time required.

EXAMPLE I. At what time will the sun be in the prime vertical, or bear West, on May 20th, 1835, in latitude 31° 45′ N.?

By Table X. the sun's declination on May 20th, 1835, is 19° 53′ North.

The latitude 32° in the left side column, and the declination 20° at the top, give 3h. 38m., the apparent time required, after noon.

* When the object is in the prime vertical, the change of altitude in one second of time will be = 15″ × co-sine of the latitude.

† When the latitude is less than the declination, and of the same name, the object will not pass the prime vertical, or East and West points; but its nearest approach thereto will be when its diurnal circle coincides with an azimuth circle.

EXAMPLE II. At what time will the sun be at its nearest approach to the prime vertical before noon on February 5th, 1835, in latitude 10° 30′ South?

By Table X. the sun's declination, February 5th, 1835, is 16° 3′ S.

| | | |
|---|---|---|
| Time corresponding to latitude 10° and declination 16° ..... | 3h. | 28m. |
| Ditto to latitude 11° and declination 16° ..... | 3 | 9 |
| | 2) 6 | 37 |
| Ditto to latitude 10° 30′, and declination 16° ..... | 3 | 18 |

In this example the latitude being less than the declination, and of the same name, the sun will not bear East, but will be at its nearest approach to that point at 3h. 18m. before noon, that is at 8h. 42m. A. M. apparent time.

EXAMPLE III. At what time will the Star Regulus bear due East on February 6th, in latitude 47° North.

| | | | |
|---|---|---|---|
| Apparent time of star's transit, February 6th, (Table XLIV.) ... | 12h. | 39m. | |
| Time corresponding to star's declination 13° N., (Table XIII.) and latitude 47° N. ..... | — 5 | 10 | |
| Apparent time of star's bearing due East ..... | 7 | 29 | P. M. |

EXAMPLE IV. At what time will the Star $\alpha$ Arietis bear nearest to the west point of the horizon on September 26th, in latitude 17° 5′ North.

| | | | |
|---|---|---|---|
| Apparent time of star's transit, September 26th, (Table XLIV.) ..... | 13h. | 44m. | |
| Time corresponding to star's declination 22° 40′ N., (Table XIII.) and latitude 17° 5′ N. ..... | 2 | 50 | |
| Time of the star's nearest approach to the West point of the horizon... | 16 | 34 | P. M. |
| Or... | 4 | 34 | A. M. |

In a similar manner, the time when a *planet* is on or near the prime vertical may be ascertained by taking out the mean time of its passage over the meridian, and its declination, from the proper page in the Nautical Almanac.

NOTE. As the meridian passages of the planets and the moon are given in the Nautical Almanac for mean time, the time when they are on or near the prime vertical, may be reduced to apparent time by applying the equation taken from Page II. of the month in the Nautical Almanac.

EXAMPLE. Required the most advantageous time for observing the altitude of the Planet Jupiter, after its meridian passage, on January 4, 1835, in order thence to compute the time at the meridian of a given place in latitude 48° N.

| | | | |
|---|---|---|---|
| Mean time of the planet's merid. passage, Jan. 4, 1835 (P. 323, N. A.) | 9h. | 7m. | |
| Time corresponding to lat. 48° N., and decl. 20° N., (ditto) is | 4 | 43 | |
| Mean time of the planet's bearing West ..... | 13 | 50 | |
| Equation of time, by Page II. of the Nautical Almanac..... | — | 5 | |
| Apparent time of the planet's bearing West..... | 13 | 45 | P. M. |
| Or... | 1 | 45 | A. M. |

If the time when the *moon* is on or near the prime vertical be required, find the mean time of its meridian passage at Greenwich, by Page IV. of the month

in the Nautical Almanac, which reduce to the time of its passing the meridian of the given place by Table XVI.: then find the corresponding time at Greenwich, as directed in Page 155; and take out the moon's declination from the Nautical Almanac, corresponding to this time.

With the moon's declination, and the latitude of the given place, find the time by the present table.* Add to this time the minutes corresponding to it, and the moon's daily variation, taken from Table XVI., and subtract the sum from, or add it to, the time of the moon's meridian passage at the given place, according as the observation is to be made before or after it, and the result will be the mean time required, which may be reduced to apparent time, by applying the equation from Page II. of the Nautical Almanac.

EXAMPLE I. Required the apparent time when the moon will be on the prime vertical, or bear due West, on August 4, 1835, in latitude 34° 56′ S., and longitude 72° East.

| | | |
|---|---|---|
| Mean time of the moon's meridian passage at Greenwich, Aug. 4, by Page IV. of the Nautical Almanac | | 8h. 33m. |
| Corr. for daily variation 59m., and longitude 72° E. (Table XVI.) | | − 11 |
| Mean time of the moon's meridian passage at the given place | | 8 22 |
| Longitude 72° E. in time (Table XIX.) | | 4 48 |
| Mean time at Greenwich when the moon passes the meridian of the given place | | 3 34 |
| Mean time of the moon's meridian passage at the given place | | 8 22 |
| Time by the table corresponding to 24° S. (the moon's declination at 3h. 34m. Greenwich mean time, by Page V. of the Naut. Alm.), and latitude 35° S. | 3h. 22m. | 3 30 |
| Corr. for daily variation 59m., and 3h. 22m. (Table XVI.) | + 8 | |
| Mean time when the moon bears West of the meridian at the given place | | 11 52 |
| Equation of time by Page II. of the Nautical Almanac | | − 6 |
| Apparent time when the moon bears West of the meridian at the given place | | 11 46 P.M. |

EXAMPLE II. At what apparent time will the moon be nearest to the prime vertical, before it has passed the meridian, on October 11, 1835, in latitude 13° N., and longitude 68° W.

| | | |
|---|---|---|
| Mean time of the moon's meridian passage at Greenwich, Oct. 11, by Page IV. of the Nautical Almanac | | 15h. 46m. |
| Corr. for daily variation 50m., and longitude 68° W. (Table XVI.) | | + 9 |
| Mean time of the moon's meridian passage at the given place | | 15 55 |
| Longitude 68° W. in time (Table XIX.) | | 4 32 |
| Mean time at Greenwich when the moon passes the meridian of the given place | | 20 27 |

* The time found by the table will not be quite correct, since it is taken out with the moon's declination at the time of its meridian passage, whereas it should be for the time of its being on or near the prime vertical; but the result will be sufficiently near the truth, for the purpose to which it is here applied.

| | | | |
|---|---|---|---|
| Mean time of the moon's meridian passage at the given place ..... | | | 15h. 55m. |
| Time from table corresponding to 25° N., (the moon's declination at 20h. 27m. Greenwich mean time, by Page VII. of the Naut. Alm.), and latitude 13° N.... | 4h. | 1m. | |
| Corr. for daily variation 50m. and 4h. 1m. (Table XVI.) | + | 8 | |
| | | 4 | 9 |
| Mean time when the moon is nearest the prime vertical, to the Eastward ..... | 11 | 46 | |
| Equation of time by Page II. of the Nautical Almanac ..... | + | 13 | |
| Apparent time when the moon is nearest the prime vertical, to the Eastward ..... | 11 | 59 | P. M. |

## TABLE XLVI.

*For finding the Altitude of a Celestial Object most advantageous for ascertaining the Apparent Time.*

By this table the altitude of a celestial object may be found nearly, when the object is in the prime vertical, or at its nearest approach thereto. It is to be entered, as in the last table, with the declination at the top, and the latitude in the left column.

EXAMPLE I. Required the altitude of the sun when it is in the prime vertical, May 20, 1835, in latitude 31° 45′ N.

The latitude 32° in the left column, and the declination 20° at the top, give the corresponding altitude 40° 12′.

EXAMPLE II. Required the altitude of the Star Regulus, when it bears due East or West, on February 6, 1835, in latitude 47° N.

The altitude in the table, corresponding to latitude 47°, and the star's declination 13°, is nearly 18°.

EXAMPLE III. Required the altitude of the Planet Jupiter, on January 4, 1835, when it is in the prime vertical, in latitude 48° N.

The altitude corresponding to latitude 48°, and the planet's declination 19° 56′ N., is about 27° 24′.

EXAMPLE IV. What will be the altitude of the moon when it is nearest to the prime vertical, eastward of the meridian, on October 11, 1835, in latitude 13° N., and longitude 68° West?

The latitude 13° N., and the moon's declination 25° N., give the moon's altitude about 32° 13′.

NOTE. *See* the above Examples worked in the explanation of the preceding table, for finding the time when an object is on or near the prime vertical.

## TABLE XLVII.

*Logarithms for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.*

The moon's right ascension and declination being given in the new Nautical Almanacs to every hour of Greenwich mean time, this table is intended principally to reduce them to any interval between the hours, by finding the proportional part of the change in one hour: the figures at the head of the columns

being taken as minutes of an hour or a degree, and those in either side column as seconds

To reduce the moon's right ascension or declination to any given mean time at Greenwich, take them out from the Nautical Almanac for the hours on the given day, preceding and following the Greenwich time, and find the hourly variation; then adding together its logarithm, and the logarithm of the minutes and seconds of the time at Greenwich since the preceding hour, their sum will be the log. of the variation or change in that time; which being applied to the right ascension or declination at the preceding hour, by addition or subtraction, according as the quantity is increasing or decreasing, the result will give them reduced to Greenwich mean time.

EXAMPLE I. Required the moon's right ascension and declination, October 6, 1835, at 14h. 36m. 15s. mean time at Greenwich.

| | | | | |
|---|---|---|---|---|
| Moon's right ascen. Oct. 6, at 14h. by Page VI. Naut. Al. | 1h. | 9m. | 15s. | |
| Ditto, ditto, at 15h. ditto ..... | 1 | 11 | 5 | |
| Variation in 1 hour, or 60 minutes ..... | | 1 | 50 | ...Log. 1.5149 |
| Mean time at Greenwich after 14h. ..... | | 36m. | 15s. | ...Log. .2188 |
| Variation or change in 36m. 15s. ..... | +h. | 1m. | 6s. | ...Log. 1.7337 |
| Moon's right ascension, October 6, at 14h..... | 1 | 9 | 15 | |
| Ditto, at 14h. 36m. 15s. Greenwich mean time | 1 | 10 | 21 | |
| Moon's declination, Oct. 6, at 14h., by Page VI. Naut. Al. | 3° | 35′ | 9″ | N. |
| Ditto ditto, at 15h. ditto ..... | 3 | 48 | 40 | N. |
| Variation in 1 hour, or 60 minutes ..... | | 13 | 31 | ...Log. .6473 |
| Mean time at Greenwich after 14h..... | | 36m. | 15s. | ...Log. .2188 |
| Variation or change in 36m. 15s. ..... | +° | 8′ | 10″ | ...Log. .8661 |
| Moon's declination, Oct. 6, at 14h. ..... | 3 | 35 | 9 | N. |
| Ditto, at 14h. 36m. 15s. Greenwich mean time | 3 | 43 | 19 | N. |

EXAMPLE II. Required the moon's right ascension and declination, May 22, 1835, at 9h. 48m. 35s. Greenwich mean time.

| | | | | |
|---|---|---|---|---|
| Moon's right ascen. May 22, at 9h. by Page X. Naut. Al. | 0h. | 43m. | 49s. | |
| Ditto, ditto, at 10h. ditto ..... | 0 | 45 | 36 | |
| Variation in 1 hour, or 60 minutes ..... | | 1 | 47 | ...Log. 1.5269 |
| Mean time at Greenwich after 9h. ..... | | 48m. | 35s. | ...Log. .0917 |
| Variation or change in 48m. 35s. ..... | +h. | 1m. | 27s. | ...Log. 1.6186 |
| Moon's right ascension, May 22, at 9h. ..... | 0 | 43 | 49 | |
| Ditto at 9h. 48m. 35s. Greenwich mean time | 0 | 45 | 16 | |
| Moon's declination, May 22, at 9h. by Page X. Naut. Al. | 0° | 10′ | 34″ | S. |
| Ditto, ditto, at 10h. ditto..... | 0 | 2 | 28 | N. |
| Variation in 1 hour, or 60 minutes ..... | | 13 | 2 | ...Log. .6631 |
| Mean time at Greenwich after 9h. ..... | | 48m. | 35s. | ...Log. .0917 |
| Variation or change in 48m. 35s. ..... | −° | 10′ | 33″ | ...Log. .7548 |
| Moon's declination, May 22, at 9h..... | 0 | 10 | 34 | S. |
| Ditto, at 9h. 48m. 35s. Greenwich mean time | 0 | 0 | 1 | S. |

## TABLE XLVIII.

*The Parallax in Altitude for Planets.*

Opposite the apparent altitude of the planet, in one of the side columns, and under the horizontal parallax, will be found its parallax in altitude, which is always to be added to the altitude of the planet.—*Example.* If the altitude of a planet be 40°, and horizontal parallax 15″, its parallax in altitude will be 12″ by the table.

## TABLE XLIX.

*To correct the Logarithmic Difference when a Planet is observed.*

The corrections in this table are to be taken out with the planet's apparent altitude in the right or left column, and the horizontal parallax (found in the Nautical Almanac) at the top, and is to be subtracted from the logarithmic difference taken from Table XXXIX.

EXAMPLE. Required the correction of the logarithmic difference corresponding to the apparent altitude of a planet 12°, and horizontal parallax 15″.

Opposite 12°, and under 15″, will be found the corresponding correction 9.

## TABLE L.

*To correct the Auxiliary Angle when a Planet is observed.*

The corrections in this table are taken out with the same arguments as the last; that is, with the planet's apparent altitude in either side column, and the horizontal parallax at the top, and is always additive to the auxiliary angle taken from Table XXX*.

EXAMPLE. Required the correction of the auxiliary angle corresponding to the apparent altitude of a planet 65°, and horizontal parallax 19″.

Opposite the apparent altitude 65°, and under the horizontal parallax 19″, is the corresponding correction 10″.

## TABLE LI.

*To reduce the Equation of Time to any Time at Greenwich.*

This table is to be entered with the daily change or variation of the equation of time (being the difference of the equations at the preceding and following noons, taken from Page I. or II. of the month in the Nautical Almanac, when they are both additive, or both subtractive, but their sum when one is subtractive, and the other additive,) at the top, and the Greenwich time in the left side column; the corresponding correction is then to be applied to the equation at the preceding noon, by addition or subtraction, according as the equation is increasing or decreasing. But should the correction exceed the equation at the preceding noon, the latter is to be subtracted from the correction, and the remainder will be the reduced equation, to be applied in the same way as directed in the Nautical Almanac for the equation at the following noon.

When the Greenwich time exceeds 12 hours, the correction must be taken out at twice, as in the third and fourth Examples.

EXAMPLE I. Required the equation of time, March 1, 1835, at 3 hours apparent time at Greenwich.

| | | |
|---|---|---|
| Equation of time at app. noon, March 1, by Page I. Naut. Al. | 12m. | 42.14s. |
| Ditto, March 2, by ditto ..... | 12 | 30.21 |
| Daily change or variation (decreasing) ..... | 0 | 11.93 or 12s. nearly. |
| Equation of time (as above) March 1..... | 12m. | 42.14s. |
| Correction to difference 12s. and 3 hours ..... | — | 1.5 |
| Reduced equation of time (to be added to apparent time)..... | 12 | 40.64 |

Hence the mean time at 3 hours apparent time at Greenwich, on March 1, 1835, is 3h. 12m. 40. 64s.

EXAMPLE II. Required the equation of time, on December 3, 1835, at 8h. 30m. apparent time at Greenwich.

| | | |
|---|---|---|
| Equation of time at apparent noon, Dec. 3, by Page I. Naut. Al. | 10m. | 8.4s. |
| Correction to daily change or variation 23.8s. and 8h. 30m. ..... | — | 8.5 |
| Reduced equation of time (to be subtracted from apparent time)... | 9 | 59.9 |

EXAMPLE III. Required the equation of time on April 8, 1835, at 16h. 35m. mean time at St. Helena, in longitude 5° 45′ W.

| | | |
|---|---|---|
| Mean time at St. Helena..... | 16h. | 35m. |
| Longitude in time (Table XIX.)..... | + | 23 W. |
| Mean time at Greenwich..... | 16 | 58 |
| Equation of time at mean noon, April 8, by Page II. of Naut. Al. | 2m. | 1.9s. |
| Corr. to daily variation 17.1s. and 12 hours... — 8.5s. | | |
| Ditto 4h. 58m.... — 3.5 ..... | — | 12.0 |
| Reduced equation of time (to be subtracted from mean time)..... | 1 | 49.9 |

EXAMPLE IV. Required the equation of time on June 15, 1835, at 18h. 30m. Greenwich apparent time.

| | | |
|---|---|---|
| Equation of time at apparent noon, June 15, by Page I. of Naut. Al. | 0m. | 4.4s. |
| Corr. to daily variation 12.6s. and 12 hours ..... 6.3s. | | |
| Ditto 6h. 30m. ..... 3.4 ..... | 0 | 9.7 |
| Reduced equation (to be added to apparent time) ..... | 0 | 5.3 |

In this example the equation of time, on June 15, at Greenwich apparent noon, is 0m. 4.4 1s. subtractive, and on the following noon it is 0m. 8. 23s. additive; therefore the equation having first decreased to 0, and then increased, their sum (12.64s.) is the amount of the daily variation or change in 24 hours; and since the correction is greater than the equation on the 15th, at apparent noon, the latter is to be subtracted from the correction, and the remainder will be the reduced equation 0m. 5. 3s., to be added to apparent time, in order to reduce it to mean time: hence the mean time corresponding to 18h. 30m. apparent time, will be 18h. 30m. + 0m. 5. 3s. = 18h. 30m. 5. 3s.

## TABLE LII.

### *Equations of equal Altitudes.*

Observations of the sun, taken when at equal altitudes, afford an easy and accurate method of ascertaining the time shewn by a chronometer at apparent or mean noon, and from thence its error: but since the sun changes his declination during the interval between the corresponding altitudes, the middle of

the times by the chronometer when they were taken, will not be that shewn by it when the sun passes the meridian; and hence it becomes necessary to apply a correction, called the equation of equal altitudes, to the middle of the times, which may be easily computed as follows, by means of this table.

RULES.—1. Opposite the interval between the observations, take out the logarithms marked A. and B. at the head of the columns.

2. To log. A. add the log. (XXIV.) of the seconds in the change of the sun's declination between the noons of the preceding and following days, (taken from the Nautical Almanac), and the log. tangent (XXV.) of the given latitude; the sum of these three logs. will be the log. (XXIV.) of the *first* part of the equation.

3. To log B. add the log. of the above seconds, and the log. co-tangent of the sun's polar distance to the nearest minute on the given day; their sum will be the log. of the *second* part of the equation.

4. The *first* part of the equation is *additive* when the declination is decreasing, and of the same name with the latitude; or increasing, and of a different name from the latitude: but *subtractive*, when the declination is increasing, and of the same name with the latitude; or decreasing, and of a different name from the latitude.

5. The *second* part of the equation is *additive* when the declination is increasing; but *subtractive* when the declination is decreasing.

EXAMPLE I. November 10, 1835, in latitude 57° 9′ N., suppose the interval between two sets of equal altitudes of the sun to be 5h. 17m.: required the equation of equal altitudes.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sun's decl. Nov. 9, by N. A. | 16° | 45′ | 15″ S. | Sun's decl. Nov. 10, by N. A. | | 17° | 3′ S. |
| Ditto Nov. 11 ..... | 17 | 19 | 16 S. | | | 90 | |
| Change of declin. in 2 days | 34 | | 1=2041″ | Sun's polar distance..... | | 107 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| Interval ..... | 5h. 17m. | Log. A. | 7.7599 | ..... Log. B. | 7.6465 |
| Change in 2 days | 2041″ | Log.... | 3.3098 | ..... | 3.3098 |
| Latitude ..... | 57° 9′ | Tang. | 0.1900 | Polar dist. 107° 3′... Co-tang. | 9.4867 |
| First part. ..... | +18.19s. | Log.... | 1.2597 | Second part +2.77s. Log. ... | 0.4430 |
| Second part..... | + 2.77 | | | | |

Eq. of equal parts + 20.96 additive, because both parts are so.

But if we suppose the above latitude to be *South*, then the first part would be subtractive, because the declination is increasing, and would be of the same name with the latitude; the second part would be additive, because the sun's declination is increasing: consequently the difference of the two parts = 15.42s. would then be the equation of equal altitudes, and subtractive, because the greater part is so.

EXAMPLE II. March 20, 1835, in latitude 20° 33′ S., suppose the interval between two sets of equal altitudes of the sun be 8h. 18m., required the equation of equal altitudes.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sun's decl. Mar. 19, by N. A. | 0° | 43′ | 15″ S. | Sun's decl. March 20 ..... | | 0° | 20′ S. |
| Ditto Mar. 21 ..... | 0 | 4 | 8 N. | | | 90 | |
| Change of declin. in 2 days | 0 | 47 | 23=2843″ | Sun's polar distance..... | | 89 | 40 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Interval ..... | 8h. 18m. | Log. A. | 7.8138 | ..... | Log. B. | 7.4818 |
| Change in 2 days | 2843″ | Log. | 3.4538 | ..... | ..... | 3.4538 |
| Latitude..... | 20° 33′ | Tang. | 9.5739 | Polar dist. 89° 40′ ... | Co-tang. | 7.7648 |
| First part ..... | + 6.94s. | Log. | 0.8415 | Second part — 0.05 | Log. | 8.7004 |
| Second part..... | — 0.05 | | | | | |
| Eq. of equal alts. | + 6.89 additive, because the greater part is so. | | | | | |

If we suppose the latitude in the above example to be *North*, the first part would be subtractive, because the declination is decreasing, and of a different name from the latitude; the second part would be subtractive, because the declination is decreasing: hence the sum of the parts, 6.99s, would be the equation of equal altitudes, and subtractive, because they are both so.

## TABLE LIII.

### *For converting Foreign Measures into English Feet or Fathoms, and the contrary.*

This table will be found very useful in converting the depths of water expressed in foreign charts, to equivalent depths in English feet or fathoms. Suppose, for example, the number of feet or pieds marked on a bank in a French chart were 17; to find the corresponding depth in English feet, look in the column, marked "French feet," for the number nearest answering to 17: this will be 16.90, opposite to which, in the left column, will be found 18, the English feet required. Or, suppose the number of Spanish brazas answering to 20 English fathoms, were required: in the column marked "Spanish brazas," opposite 20 in the column of English fathoms, will be found 21.58, the number of Spanish brazas equivalent to 20 English fathoms.

The columns in the table were computed by the following rules:

1. *To reduce English feet to French feet, or English fathoms to French toises*, add the log. 9.972647 to the log. of the given number of English feet or fathoms, and the sum will be the log. of the corresponding French feet or toises.

2. *To reduce English fathoms to French brasses*, add the log. 0.051516 to the log. of the given number of English fathoms.

3. *To reduce English fathoms or feet to Spanish brazas or feet*, add the log. 0.033074 to the log. of the English fathoms or feet.

4. *To reduce English feet to Portuguese feet*, add the log. 9.966926 to the log. of the English feet.

5. *To reduce English fathoms to Portuguese brazas or fathoms*, add the log. 9.920818 to the log. of the English feet.

6. *To reduce English feet to Amsterdam feet*, add the log. 0.032292 to the log. of the English feet.

7. *To reduce English feet to Rynland feet*, add the log. 9.987514 to the log. of the English feet.

8. *To reduce English feet or fathoms to Swedish feet or fathoms*, add the log. 0.011570 to the log. of the English feet.

9. *To reduce English feet to Venetian feet*, add the log. 9.943094 to the log. of the English feet.

10. *To reduce English fathoms to Venetian passi*, add the log. 0.022276 to the log. of the English fathoms.

11. *To reduce English feet to Russian feet*, add the log. 9.940878 to the log. of the English feet.

The pages not admitting of more columns, the following rules may be added:

1. *To reduce English feet or fathoms to Danish feet or fathoms*, add the log. 9.987501 to the log. of the English feet or fathoms.

2. *To reduce English fathoms to Russian sagenes or sashes*, add the log. 9.933085 to the log. of the English fathoms.

## TABLE LIV.

### *For finding the exact Greenwich Time corresponding to the true Lunar Distance.*

If the moon's motion in the heavens were uniform, the true lunar distance would always give the corresponding Greenwich mean time by the Rule in page 270; but as this is not the case, when great accuracy is desired, the interval found by the proportional logarithms should be corrected by a number of seconds taken from this table, in the following manner.

Find the difference between the prop. logs. standing opposite the two distances in the Almanac, which include the given true distance: with this difference at the top of the table, and the approximate interval in one of the left columns, take out the correction in seconds, which *add* to the approximate interval when the prop. logs. are *decreasing*, or *subtract* from it when *increasing*, and the result will be the true interval.

EXAMPLE I. Required the correct time at Greenwich corresponding to 79° 39′ 13″, the true distance between the sun and moon, on June 3, 1835. (*See* Example I. page 274).

| | | | | |
|---|---|---|---|---|
| The true distance at 0h. by Page XIII. of the Naut. Al. is | | 79° 35′ | 6″ | its P. Log. 2898 |
| Ditto at IIIh. | ditto | 81 7 | 28 | its P. Log. 2884 |
| | Difference ..... | | | 14 |
| Correction in the table opposite the approximate interval 8m. 1s. and under 10 | | | | 1s. |
| Ditto | ditto | and under 4 | | 0 |
| | Correction of approximate interval..... | | | 1 |

The above correction 1s. being *added* to the approximate interval 8m. 1s., because the prop logs. are *decreasing*, the sum 8m. 2s. is the true interval: hence the exact Greenwich mean time is 0h. 8m. 2s.

EXAMPLE II. Required the exact Greenwich time corresponding to 52° 13′ 19″, the true distance between the moon and the Star α Aquilæ, on July 7th, 1835. (*See* Example VII. page 294.)

| | | | | |
|---|---|---|---|---|
| The true distance at XII. hrs. by Page XIV. of Naut. Al. is | | 52° 37′ | 3″ | its P. L. 3569 |
| Ditto at XV. hrs. | ditto | 51 17 | 55 | its P. L. 3646 |
| | Difference ..... | | | 77 |
| Correction in the table opp. the approximate interval 0h. 54m. and under 70 is | | | | 18s. |
| Ditto | ditto | and under 7 is | | 2 |
| | Correction of the approximate interval | | | 20 |

The correction 20s. being *subtracted* from the approximate interval 0h. 53m. 59s., because the prop. logs. are *increasing*, the remainder 0h. 53m. 39s. is the true interval: and hence the exact Greenwich mean time is 12h. 53m. 39s.

The omission of this correction in the above Example would produce an error of 5 miles in the longitude. But this is an extreme case.

## TABLE LV.

### *To reduce the Moon's Horizontal Parallax, or Semidiameter, to any Time under the Meridian of Greenwich.*

This table contains the proportional parts to be applied to the moon's horizontal parallax and semidiameter, (given in the Nautical Almanac for noon and midnight), in order to reduce them to the time of observation: it is to be entered with the Greenwich time after noon or midnight at the top, and the difference in 12 hours in either side column. The proportional parts thus found are to be added to, or subtracted from, the horizontal parallax and semidiameter, at the preceding noon or midnight, according as they are increasing or decreasing.

## TABLE LVI.

### *Latitudes and Longitudes.**

This table contains the latitudes and longitudes, from the meridian of Greenwich, of the principal ports, harbours, capes, shoals, rocks, &c. in the world. It is divided into sections, and arranged according to the country, sea, or coast, to which they belong. The manner of finding any required place, supposing its situation nearly known, is so obvious, that it needs no further explanation.

The variation of the compass, as it stands at the present time, is occasionally inserted for the information of such persons as may not have an opportunity of finding it by observation.

## TABLE LVII.

### *Times of High Water.*

This table contains the times of high water on the full and change of the moon, at the principal ports, and along the coasts, particularly of Great Britain and Ireland, with the vertical rise of the tide in feet at spring tides; the names of the places being alphabetically arranged.

---

* The Author, impressed with the importance of this table, has used every exertion to render it as complete and correct as possible, by consulting the works of the best Navigators and Astronomers, at the same time comparing them with the most accurate charts and surveys, and by procuring the assistance of his nautical friends, from whom it has received considerable improvements: he therefore flatters himself the present table may be esteemed not only one of the most extensive, but likewise the most correct, of any hitherto published. Conscious, however, that errors must exist in a table which depends on observation (although he trusts they are few and inconsiderable), he takes this opportunity of earnestly requesting the intelligent mariner to communicate to him any he may discover; for it is only by the accumulated knowledge of such men, that we can hope to approach perfection on hydrographical subjects.

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# TABLE I.

## Difference of Latitude and Departure for ¼ Point.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.0 | 61 | 60.9 | 03.0 | 121 | 120.9 | 05.9 | 181 | 180.8 | 08.9 | 241 | 240.7 | 11.8 |
| 2 | 02.0 | 00.1 | 62 | 61.9 | 03.0 | 122 | 121.9 | 06.0 | 182 | 181.8 | 08.9 | 242 | 241.7 | 11.9 |
| 3 | 03.0 | 00.1 | 63 | 62.9 | 03.1 | 123 | 122.9 | 06.0 | 183 | 182.8 | 09.0 | 243 | 242.7 | 11.9 |
| 4 | 04.0 | 00.2 | 64 | 63.9 | 03.1 | 124 | 123.9 | 06.1 | 184 | 183.8 | 09.0 | 244 | 243.7 | 12.0 |
| 5 | 05.0 | 00.2 | 65 | 64.9 | 03.2 | 125 | 124.9 | 06.1 | 185 | 184.8 | 09.1 | 245 | 244.7 | 12.0 |
| 6 | 06.0 | 00.3 | 66 | 65.9 | 03.2 | 126 | 125.8 | 06.2 | 186 | 185.8 | 09.1 | 246 | 245.7 | 12.1 |
| 7 | 07.0 | 00.3 | 67 | 66.9 | 03.3 | 127 | 126.8 | 06.2 | 187 | 186.8 | 09.2 | 247 | 246.7 | 12.1 |
| 8 | 08.0 | 00.4 | 68 | 67.9 | 03.3 | 128 | 127.8 | 06.3 | 188 | 187.8 | 09.2 | 248 | 247.7 | 12.2 |
| 9 | 09.0 | 00.4 | 69 | 68.9 | 03.4 | 129 | 128.8 | 06.3 | 189 | 188.8 | 09.3 | 249 | 248.7 | 12.2 |
| 10 | 10.0 | 00.5 | 70 | 69.9 | 03.4 | 130 | 129.8 | 06.4 | 190 | 189.8 | 09.3 | 250 | 249.7 | 12.3 |
| 11 | 11.0 | 00.5 | 71 | 70.9 | 03.5 | 131 | 130.8 | 06.4 | 191 | 190.8 | 09.4 | 251 | 250.7 | 12.3 |
| 12 | 12.0 | 00.6 | 72 | 71.9 | 03.5 | 132 | 131.8 | 06.5 | 192 | 191.8 | 09.4 | 252 | 251.7 | 12.4 |
| 13 | 13.0 | 00.6 | 73 | 72.9 | 03.6 | 133 | 132.8 | 06.5 | 193 | 192.8 | 09.5 | 253 | 252.7 | 12.4 |
| 14 | 14.0 | 00.7 | 74 | 73.9 | 03.6 | 134 | 133.8 | 06.6 | 194 | 193.8 | 09.5 | 254 | 253.7 | 12.5 |
| 15 | 15.0 | 00.7 | 75 | 74.9 | 03.7 | 135 | 134.8 | 06.6 | 195 | 194.8 | 09.6 | 255 | 254.7 | 12.5 |
| 16 | 16.0 | 00.8 | 76 | 75.9 | 03.7 | 136 | 135.8 | 06.7 | 196 | 195.8 | 09.6 | 256 | 255.7 | 12.6 |
| 17 | 17.0 | 00.8 | 77 | 76.9 | 03.8 | 137 | 136.8 | 06.7 | 197 | 196.8 | 09.7 | 257 | 256.7 | 12.6 |
| 18 | 18.0 | 00.9 | 78 | 77.9 | 03.8 | 138 | 137.8 | 06.8 | 198 | 197.8 | 09.7 | 258 | 257.7 | 12.7 |
| 19 | 19.0 | 00.9 | 79 | 78.9 | 03.9 | 139 | 138.8 | 06.8 | 199 | 198.8 | 09.8 | 259 | 258.7 | 12.7 |
| 20 | 20.0 | 01.0 | 80 | 79.9 | 03.9 | 140 | 139.8 | 06.9 | 200 | 199.8 | 09.8 | 260 | 259.7 | 12.8 |
| 21 | 21.0 | 01.0 | 81 | 80.9 | 04.0 | 141 | 140.8 | 06.9 | 201 | 200.8 | 09.9 | 261 | 260.7 | 12.8 |
| 22 | 22.0 | 01.1 | 82 | 81.9 | 04.0 | 142 | 141.8 | 07.0 | 202 | 201.8 | 09.9 | 262 | 261.7 | 12.9 |
| 23 | 23.0 | 01.1 | 83 | 82.9 | 04.1 | 143 | 142.8 | 07.0 | 203 | 202.8 | 10.0 | 263 | 262.7 | 12.9 |
| 24 | 24.0 | 01.2 | 84 | 83.9 | 04.1 | 144 | 143.8 | 07.1 | 204 | 203.8 | 10.0 | 264 | 263.7 | 13.0 |
| 25 | 25.0 | 01.2 | 85 | 84.9 | 04.2 | 145 | 144.8 | 07.1 | 205 | 204.8 | 10.1 | 265 | 264.7 | 13.0 |
| 26 | 26.0 | 01.3 | 86 | 85.9 | 04.2 | 146 | 145.8 | 07.2 | 206 | 205.8 | 10.1 | 266 | 265.7 | 13.1 |
| 27 | 27.0 | 01.3 | 87 | 86.9 | 04.3 | 147 | 146.8 | 07.2 | 207 | 206.8 | 10.2 | 267 | 266.7 | 13.1 |
| 28 | 28.0 | 01.4 | 88 | 87.9 | 04.3 | 148 | 147.8 | 07.3 | 208 | 207.8 | 10.2 | 268 | 267.7 | 13.2 |
| 29 | 29.0 | 01.4 | 89 | 88.9 | 04.4 | 149 | 148.8 | 07.3 | 209 | 208.8 | 10.3 | 269 | 268.7 | 13.2 |
| 30 | 30.0 | 01.5 | 90 | 89.9 | 04.4 | 150 | 149.8 | 07.4 | 210 | 209.8 | 10.3 | 270 | 269.7 | 13.3 |
| 31 | 31.0 | 01.5 | 91 | 90.9 | 04.5 | 151 | 150.8 | 07.4 | 211 | 210.7 | 10.4 | 271 | 270.7 | 13.3 |
| 32 | 32.0 | 01.6 | 92 | 91.9 | 04.5 | 152 | 151.8 | 07.5 | 212 | 211.7 | 10.4 | 272 | 271.7 | 13.3 |
| 33 | 33.0 | 01.6 | 93 | 92.9 | 04.6 | 153 | 152.8 | 07.5 | 213 | 212.7 | 10.5 | 273 | 272.7 | 13.4 |
| 34 | 34.0 | 01.7 | 94 | 93.9 | 04.6 | 154 | 153.8 | 07.6 | 214 | 213.7 | 10.5 | 274 | 273.7 | 13.4 |
| 35 | 35.0 | 01.7 | 95 | 94.9 | 04.7 | 155 | 154.8 | 07.6 | 215 | 214.7 | 10.6 | 275 | 274.7 | 13.5 |
| 36 | 36.0 | 01.8 | 96 | 95.9 | 04.7 | 156 | 155.8 | 07.7 | 216 | 215.7 | 10.6 | 276 | 275.7 | 13.5 |
| 37 | 37.0 | 01.8 | 97 | 96.9 | 04.8 | 157 | 156.8 | 07.7 | 217 | 216.7 | 10.7 | 277 | 276.7 | 13.6 |
| 38 | 38.0 | 01.9 | 98 | 97.9 | 04.8 | 158 | 157.8 | 07.8 | 218 | 217.7 | 10.7 | 278 | 277.7 | 13.6 |
| 39 | 39.0 | 01.9 | 99 | 98.9 | 04.9 | 159 | 158.8 | 07.8 | 219 | 218.7 | 10.8 | 279 | 278.7 | 13.7 |
| 40 | 40.0 | 02.0 | 100 | 99.9 | 04.9 | 160 | 159.8 | 07.9 | 220 | 219.7 | 10.8 | 280 | 279.7 | 13.7 |
| 41 | 41.0 | 02.0 | 101 | 100.9 | 05.0 | 161 | 160.8 | 07.9 | 221 | 220.7 | 10.8 | 281 | 280.7 | 13.8 |
| 42 | 41.9 | 02.1 | 102 | 101.9 | 05.0 | 162 | 161.8 | 08.0 | 222 | 221.7 | 10.9 | 282 | 281.7 | 13.8 |
| 43 | 42.9 | 02.1 | 103 | 102.9 | 05.1 | 163 | 162.8 | 08.0 | 223 | 222.7 | 10.9 | 283 | 282.7 | 13.9 |
| 44 | 43.9 | 02.2 | 104 | 103.9 | 05.1 | 164 | 163.8 | 08.1 | 224 | 223.7 | 11.0 | 284 | 283.7 | 13.9 |
| 45 | 44.9 | 02.2 | 105 | 104.9 | 05.2 | 165 | 164.8 | 08.1 | 225 | 224.7 | 11.0 | 285 | 284.7 | 14.0 |
| 46 | 45.9 | 02.3 | 106 | 105.9 | 05.2 | 166 | 165.8 | 08.2 | 226 | 225.7 | 11.1 | 286 | 285.7 | 14.0 |
| 47 | 46.9 | 02.3 | 107 | 106.9 | 05.3 | 167 | 166.8 | 08.2 | 227 | 226.7 | 11.1 | 287 | 286.7 | 14.1 |
| 48 | 47.9 | 02.4 | 108 | 107.9 | 05.3 | 168 | 167.8 | 08.2 | 228 | 227.7 | 11.2 | 288 | 287.7 | 14.1 |
| 49 | 48.9 | 02.4 | 109 | 108.9 | 05.4 | 169 | 168.8 | 08.3 | 229 | 228.7 | 11.2 | 289 | 288.7 | 14.2 |
| 50 | 49.9 | 02.5 | 110 | 109.9 | 05.4 | 170 | 169.8 | 08.3 | 230 | 229.7 | 11.3 | 290 | 289.7 | 14.2 |
| 51 | 50.9 | 02.5 | 111 | 110.9 | 05.5 | 171 | 170.8 | 08.4 | 231 | 230.7 | 11.3 | 291 | 290.7 | 14.3 |
| 52 | 51.9 | 02.6 | 112 | 111.9 | 05.5 | 172 | 171.8 | 08.4 | 232 | 231.7 | 11.4 | 292 | 291.7 | 14.3 |
| 53 | 52.9 | 02.6 | 113 | 112.9 | 05.5 | 173 | 172.8 | 08.5 | 233 | 232.7 | 11.4 | 293 | 292.7 | 14.4 |
| 54 | 53.9 | 02.7 | 114 | 113.9 | 05.6 | 174 | 173.8 | 08.5 | 234 | 233.7 | 11.5 | 294 | 293.6 | 14.4 |
| 55 | 54.9 | 02.7 | 115 | 114.9 | 05.6 | 175 | 174.8 | 08.6 | 235 | 234.7 | 11.5 | 295 | 294.6 | 14.5 |
| 56 | 55.9 | 02.8 | 116 | 115.9 | 05.7 | 176 | 175.8 | 08.6 | 236 | 235.7 | 11.6 | 296 | 295.6 | 14.5 |
| 57 | 56.9 | 02.8 | 117 | 116.9 | 05.7 | 177 | 176.8 | 08.7 | 237 | 236.7 | 11.6 | 297 | 296.6 | 14.6 |
| 58 | 57.9 | 02.9 | 118 | 117.9 | 05.8 | 178 | 177.8 | 08.7 | 238 | 237.7 | 11.7 | 298 | 297.6 | 14.6 |
| 59 | 58.9 | 02.9 | 119 | 118.9 | 05.8 | 179 | 178.8 | 08.8 | 239 | 238.7 | 11.7 | 299 | 298.6 | 14.7 |
| 60 | 59.9 | 02.9 | 120 | 119.9 | 05.9 | 180 | 179.8 | 08.8 | 240 | 239.7 | 11.8 | 300 | 299.6 | 14.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE I.

## Difference of Latitude and Departure for ½ Point.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.7 | 06.0 | 121 | 120.4 | 11.9 | 181 | 180.1 | 17.7 | 241 | 239.8 | 23.6 |
| 2 | 02.0 | 00.2 | 62 | 61.7 | 06.1 | 122 | 121.4 | 12.0 | 182 | 181.1 | 17.8 | 242 | 240.8 | 23.7 |
| 3 | 03.0 | 00.3 | 63 | 62.7 | 06.2 | 123 | 122.4 | 12.1 | 183 | 182.1 | 17.9 | 243 | 241.8 | 23.8 |
| 4 | 04.0 | 00.4 | 64 | 63.7 | 06.3 | 124 | 123.4 | 12.2 | 184 | 183.1 | 18.0 | 244 | 242.8 | 23.9 |
| 5 | 05.0 | 00.5 | 65 | 64.7 | 06.4 | 125 | 124.4 | 12.3 | 185 | 184.1 | 18.1 | 245 | 243.8 | 24.0 |
| 6 | 06.0 | 00.6 | 66 | 65.7 | 06.5 | 126 | 125.4 | 12.3 | 186 | 185.1 | 18.2 | 246 | 244.8 | 24.1 |
| 7 | 07.0 | 00.7 | 67 | 66.7 | 06.6 | 127 | 126.4 | 12.4 | 187 | 186.1 | 18.3 | 247 | 245.8 | 24.2 |
| 8 | 08.0 | 00.8 | 68 | 67.7 | 06.7 | 128 | 127.4 | 12.5 | 188 | 187.1 | 18.4 | 248 | 246.8 | 24.3 |
| 9 | 09.0 | 00.9 | 69 | 68.7 | 06.8 | 129 | 128.4 | 12.6 | 189 | 188.1 | 18.5 | 249 | 247.8 | 24.4 |
| 10 | 10.0 | 01.0 | 70 | 69.7 | 06.9 | 130 | 129.4 | 12.7 | 190 | 189.1 | 18.6 | 250 | 248.8 | 24.5 |
| 11 | 10.9 | 01.1 | 71 | 70.7 | 07.0 | 131 | 130.4 | 12.8 | 191 | 190.1 | 18.7 | 251 | 249.8 | 24.6 |
| 12 | 11.9 | 01.2 | 72 | 71.7 | 07.1 | 132 | 131.4 | 12.9 | 192 | 191.1 | 18.8 | 252 | 250.8 | 24.7 |
| 13 | 12.9 | 01.3 | 73 | 72.6 | 07.2 | 133 | 132.4 | 13.0 | 193 | 192.1 | 18.9 | 253 | 251.8 | 24.8 |
| 14 | 13 9 | 01.4 | 74 | 73.6 | 07.3 | 134 | 133.4 | 13.1 | 194 | 193.1 | 19.0 | 254 | 252.8 | 24.9 |
| 15 | 14.9 | 01.5 | 75 | 74.6 | 07.4 | 135 | 134.3 | 13.2 | 195 | 194.1 | 19.1 | 255 | 253.8 | 25.0 |
| 16 | 15.9 | 01.6 | 76 | 75.6 | 07.4 | 136 | 135.3 | 13.3 | 196 | 195.1 | 19.2 | 256 | 254.8 | 25.1 |
| 17 | 16.9 | 01.7 | 77 | 76.6 | 07.5 | 137 | 136.3 | 13.4 | 197 | 196.1 | 19.3 | 257 | 255.8 | 25.2 |
| 18 | 17.9 | 01.8 | 78 | 77.6 | 07.6 | 138 | 137.3 | 13.5 | 198 | 197.0 | 19.4 | 258 | 256.8 | 25.3 |
| 19 | 18.9 | 01.9 | 79 | 78.6 | 07.7 | 139 | 138.3 | 13.6 | 199 | 198.0 | 19.5 | 259 | 257.8 | 25.4 |
| 20 | 19.9 | 02.0 | 80 | 79.6 | 07.8 | 140 | 139.3 | 13.7 | 200 | 199.0 | 19.6 | 260 | 258.7 | 25.5 |
| 21 | 20.9 | 02.1 | 81 | 80.6 | 07.9 | 141 | 140.3 | 13.8 | 201 | 200.0 | 19.7 | 261 | 259.7 | 25.6 |
| 22 | 21.9 | 02.2 | 82 | 81.6 | 08.0 | 142 | 141.3 | 13.9 | 202 | 201.0 | 19.8 | 262 | 260.7 | 25.7 |
| 23 | 22.9 | 02.3 | 83 | 82.6 | 08.1 | 143 | 142.3 | 14.0 | 203 | 202.0 | 19.9 | 263 | 261.7 | 25.8 |
| 24 | 23.9 | 02.4 | 84 | 83.6 | 08.2 | 144 | 143.3 | 14.1 | 204 | 203.0 | 20.0 | 264 | 262.7 | 25.9 |
| 25 | 24.9 | 02.4 | 85 | 84.6 | 08.3 | 145 | 144.3 | 14.2 | 205 | 204.0 | 20.1 | 265 | 263.7 | 26.0 |
| 26 | 25.9 | 02.5 | 86 | 85.6 | 08.4 | 146 | 145.3 | 14.3 | 206 | 205.0 | 20.2 | 266 | 264.7 | 26.1 |
| 27 | 26.9 | 02.6 | 87 | 86.6 | 08.5 | 147 | 146.3 | 14.4 | 207 | 206.0 | 20.3 | 267 | 265.7 | 26.2 |
| 28 | 27.9 | 02.7 | 88 | 87.6 | 08.6 | 148 | 147.3 | 14.5 | 208 | 207.0 | 20.4 | 268 | 266.7 | 26.3 |
| 29 | 28.9 | 02.8 | 89 | 88.6 | 08.7 | 149 | 148.3 | 14.6 | 209 | 208.0 | 20.5 | 269 | 267.7 | 26.4 |
| 30 | 29.9 | 02.9 | 90 | 89.6 | 08.8 | 150 | 149.3 | 14.7 | 210 | 209.0 | 20.6 | 270 | 268.7 | 26.5 |
| 31 | 30.9 | 03.0 | 91 | 90.6 | 08.9 | 151 | 150.3 | 14.8 | 211 | 210.0 | 20.7 | 271 | 269.7 | 26.6 |
| 32 | 31.8 | 03.1 | 92 | 91.6 | 09.0 | 152 | 151.3 | 14.9 | 212 | 211.0 | 20.8 | 272 | 270.7 | 26.7 |
| 33 | 32.8 | 03.2 | 93 | 92.6 | 09.1 | 153 | 152.3 | 15.0 | 213 | 212.0 | 20.9 | 273 | 271.7 | 26.8 |
| 34 | 33.8 | 03.3 | 94 | 93.5 | 09.2 | 154 | 153.3 | 15.1 | 214 | 213.0 | 21.0 | 274 | 272.7 | 26.9 |
| 35 | 34.8 | 03.4 | 95 | 94.5 | 09.3 | 155 | 154.3 | 15.2 | 215 | 214.0 | 21.1 | 275 | 273.7 | 27.0 |
| 36 | 35.8 | 03.5 | 96 | 95.5 | 09.4 | 156 | 155.2 | 15.3 | 216 | 215.0 | 21.2 | 276 | 274.7 | 27.1 |
| 37 | 36.8 | 03.6 | 97 | 96.5 | 09.5 | 157 | 156.2 | 15.4 | 217 | 216.0 | 21.3 | 277 | 275.7 | 27.2 |
| 38 | 37.8 | 03.7 | 98 | 97.5 | 09.6 | 158 | 157.2 | 15.5 | 218 | 216.9 | 21.4 | 278 | 276.7 | 27.3 |
| 39 | 38.8 | 03.8 | 99 | 98.5 | 09.7 | 159 | 158.2 | 15.6 | 219 | 217.9 | 21.5 | 279 | 277.7 | 27.3 |
| 40 | 39.8 | 03.9 | 100 | 99.5 | 09.8 | 160 | 159.2 | 15.7 | 220 | 218.9 | 21.6 | 280 | 278.7 | 27.4 |
| 41 | 40.8 | 04.0 | 101 | 100.5 | 09.9 | 161 | 160.2 | 15.8 | 221 | 219.9 | 21.7 | 281 | 279.6 | 27.5 |
| 42 | 41.8 | 04.1 | 102 | 101.5 | 10.0 | 162 | 161.2 | 15.9 | 222 | 220.9 | 21.8 | 282 | 280.6 | 27.6 |
| 43 | 42.8 | 04.2 | 103 | 102.5 | 10.1 | 163 | 162.2 | 16.0 | 223 | 221.9 | 21.9 | 283 | 281.6 | 27.7 |
| 44 | 43.8 | 04.3 | 104 | 103.5 | 10.2 | 164 | 163.2 | 16.1 | 224 | 222.9 | 22.0 | 284 | 282.6 | 27.8 |
| 45 | 44.8 | 04.4 | 105 | 104.5 | 10.3 | 165 | 164.2 | 16.2 | 225 | 223.9 | 22.1 | 285 | 283.6 | 27.9 |
| 46 | 45.8 | 04.5 | 106 | 105.5 | 10.4 | 166 | 165.2 | 16.3 | 226 | 224.9 | 22.2 | 286 | 284.6 | 28.0 |
| 47 | 46.8 | 04.6 | 107 | 106.5 | 10.5 | 167 | 166.2 | 16.4 | 227 | 225.9 | 22.2 | 287 | 285.6 | 28.1 |
| 48 | 47.8 | 04.7 | 108 | 107.5 | 10.6 | 168 | 167.2 | 16.5 | 228 | 226.9 | 22.3 | 288 | 286.6 | 28.2 |
| 49 | 48.8 | 04.8 | 109 | 108.5 | 10.7 | 169 | 168.2 | 16.6 | 229 | 227.9 | 22.4 | 289 | 287.6 | 28.3 |
| 50 | 49.8 | 04.9 | 110 | 109.5 | 10.8 | 170 | 169.2 | 16.7 | 230 | 228.9 | 22.5 | 290 | 288.6 | 28.4 |
| 51 | 50.8 | 05.0 | 111 | 110.5 | 10.9 | 171 | 170.2 | 16.8 | 231 | 229.9 | 22.6 | 291 | 289.6 | 28.5 |
| 52 | 51.7 | 05.1 | 112 | 111.5 | 11.0 | 172 | 171.2 | 16.9 | 232 | 230.9 | 22.7 | 292 | 290.6 | 28.6 |
| 53 | 52.7 | 05.2 | 113 | 112.5 | 11.1 | 173 | 172.2 | 17.0 | 233 | 231.9 | 22.8 | 293 | 291.6 | 28.7 |
| 54 | 53.7 | 05.3 | 114 | 113.5 | 11.2 | 174 | 173.2 | 17.1 | 234 | 232.9 | 22.9 | 294 | 292.6 | 28.8 |
| 55 | 54.7 | 05.4 | 115 | 114.4 | 11.3 | 175 | 174.2 | 17.2 | 235 | 233.9 | 23.0 | 295 | 293.6 | 28.9 |
| 56 | 55.7 | 05.5 | 116 | 115.4 | 11.4 | 176 | 175.2 | 17.3 | 236 | 234.9 | 23.1 | 296 | 294.6 | 29.0 |
| 57 | 56.7 | 05.6 | 117 | 116.4 | 11.5 | 177 | 176.1 | 17.4 | 237 | 235.9 | 23.2 | 297 | 295.6 | 29.1 |
| 58 | 57.7 | 05.7 | 118 | 117.4 | 11.6 | 178 | 177.1 | 17.4 | 238 | 236.9 | 23.3 | 298 | 296.6 | 29.2 |
| 59 | 58.7 | 05.8 | 119 | 118.4 | 11.7 | 179 | 178.1 | 17.5 | 239 | 237.8 | 23.4 | 299 | 297.6 | 29.3 |
| 60 | 59.7 | 05.9 | 120 | 119.4 | 11.8 | 180 | 179.1 | 17.6 | 240 | 238.8 | 23.5 | 300 | 298.6 | 29.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE I.

## Difference of Latitude and Departure for ¾ Point.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.3 | 09.0 | 121 | 119.7 | 17.8 | 181 | 179.0 | 26.6 | 241 | 238.4 | 35.4 |
| 2 | 02.0 | 00.3 | 62 | 61.3 | 09.1 | 122 | 120.7 | 17.9 | 182 | 180.0 | 26.7 | 242 | 239.4 | 35.5 |
| 3 | 03.0 | 00.4 | 63 | 62.3 | 09.2 | 123 | 121.7 | 18.1 | 183 | 181.0 | 26.9 | 243 | 240.4 | 35.7 |
| 4 | 04.0 | 00.6 | 64 | 63.3 | 09.4 | 124 | 122.7 | 18.2 | 184 | 182.0 | 27.0 | 244 | 241.4 | 35.8 |
| 5 | 04.9 | 00.7 | 65 | 64.3 | 09.5 | 125 | 123.7 | 18.3 | 185 | 183.0 | 27.2 | 245 | 242.4 | 36.0 |
| 6 | 05.9 | 00.9 | 66 | 65.3 | 09.7 | 126 | 124.6 | 18.5 | 186 | 184.0 | 27.3 | 246 | 243.3 | 36.1 |
| 7 | 06.9 | 01.0 | 67 | 66.3 | 09.8 | 127 | 125.6 | 18.6 | 187 | 185.0 | 27.4 | 247 | 244.3 | 36.2 |
| 8 | 07.9 | 01.2 | 68 | 67.3 | 10.0 | 128 | 126.6 | 18.8 | 188 | 186.0 | 27.6 | 248 | 245.3 | 36.4 |
| 9 | 08.9 | 01.3 | 69 | 68.3 | 10.1 | 129 | 127.6 | 18.9 | 189 | 187.0 | 27.7 | 249 | 246.3 | 36.5 |
| 10 | 09.9 | 01.5 | 70 | 69.2 | 10.3 | 130 | 128.6 | 19.1 | 190 | 187.9 | 27.9 | 250 | 247.3 | 36.7 |
| 11 | 10.9 | 01.6 | 71 | 70.2 | 10.4 | 131 | 129.6 | 19.2 | 191 | 188.9 | 28.0 | 251 | 248.3 | 36.8 |
| 12 | 11.9 | 01.8 | 72 | 71.2 | 10.6 | 132 | 130.6 | 19.4 | 192 | 189.9 | 28.2 | 252 | 249.3 | 37.0 |
| 13 | 12.9 | 01.9 | 73 | 72.2 | 10.7 | 133 | 131.6 | 19.5 | 193 | 190.9 | 28.3 | 253 | 250.3 | 37.1 |
| 14 | 13.9 | 02.1 | 74 | 73.2 | 10.9 | 134 | 132.6 | 19.7 | 194 | 191.9 | 28.5 | 254 | 251.3 | 37.3 |
| 15 | 14.8 | 02.2 | 75 | 74.2 | 11.0 | 135 | 133.5 | 19.8 | 195 | 192.9 | 28.6 | 255 | 252.2 | 37.4 |
| 16 | 15.8 | 02.3 | 76 | 75.2 | 11.2 | 136 | 134.5 | 20.0 | 196 | 193.9 | 28.8 | 256 | 253.2 | 37.6 |
| 17 | 16.8 | 02.5 | 77 | 76.2 | 11.3 | 137 | 135.5 | 20.1 | 197 | 194.9 | 28.9 | 257 | 254.2 | 37.7 |
| 18 | 17.8 | 02.6 | 78 | 77.2 | 11.4 | 138 | 136.5 | 20.3 | 198 | 195.9 | 29.1 | 258 | 255.2 | 37.9 |
| 19 | 18.8 | 02.8 | 79 | 78.1 | 11.6 | 139 | 137.5 | 20.4 | 199 | 196.8 | 29.2 | 259 | 256.2 | 38.0 |
| 20 | 19.8 | 02.9 | 80 | 79.1 | 11.7 | 140 | 138.5 | 20.5 | 200 | 197.8 | 29.4 | 260 | 257.2 | 38.2 |
| 21 | 20.8 | 03.1 | 81 | 80.1 | 11.9 | 141 | 139.5 | 20.7 | 201 | 198.8 | 29.5 | 261 | 258.2 | 38.3 |
| 22 | 21.8 | 03.2 | 82 | 81.1 | 12.0 | 142 | 140.5 | 20.8 | 202 | 199.8 | 29.6 | 262 | 259.2 | 38.4 |
| 23 | 22.8 | 03.4 | 83 | 82.1 | 12.2 | 143 | 141.5 | 21.0 | 203 | 200.8 | 29.8 | 263 | 260.2 | 38.6 |
| 24 | 23.7 | 03.5 | 84 | 83.1 | 12.3 | 144 | 142.4 | 21.1 | 204 | 201.8 | 29.9 | 264 | 261.1 | 38.7 |
| 25 | 24.7 | 03.7 | 85 | 84.1 | 12.5 | 145 | 143.4 | 21.3 | 205 | 202.8 | 30.1 | 265 | 262.1 | 38.9 |
| 26 | 25.7 | 03.8 | 86 | 85.1 | 12.6 | 146 | 144.4 | 21.4 | 206 | 203.8 | 30.2 | 266 | 263.1 | 39.0 |
| 27 | 26.7 | 04.0 | 87 | 86.1 | 12.8 | 147 | 145.4 | 21.6 | 207 | 204.8 | 30.4 | 267 | 264.1 | 39.2 |
| 28 | 27.7 | 04.1 | 88 | 87.1 | 12.9 | 148 | 146.4 | 21.7 | 208 | 205.8 | 30.5 | 268 | 265.1 | 39.3 |
| 29 | 28.7 | 04.3 | 89 | 88.0 | 13.1 | 149 | 147.4 | 21.9 | 209 | 206.7 | 30.7 | 269 | 266.1 | 39.5 |
| 30 | 29.7 | 04.4 | 90 | 89.0 | 13.2 | 150 | 148.4 | 22.0 | 210 | 207.7 | 30.8 | 270 | 267.1 | 39.6 |
| 31 | 30.7 | 04.6 | 91 | 90.0 | 13.4 | 151 | 149.4 | 22.2 | 211 | 208.7 | 31.0 | 271 | 268.1 | 39.8 |
| 32 | 31.7 | 04.7 | 92 | 91.0 | 13.5 | 152 | 150.4 | 22.3 | 212 | 209.7 | 31.1 | 272 | 269.1 | 39.9 |
| 33 | 32.6 | 04.8 | 93 | 92.0 | 13.7 | 153 | 151.3 | 22.5 | 213 | 210.7 | 31.3 | 273 | 270.0 | 40.1 |
| 34 | 33.6 | 05.0 | 94 | 93.0 | 13.8 | 154 | 152.3 | 22.6 | 214 | 211.7 | 31.4 | 274 | 271.0 | 40.2 |
| 35 | 34.6 | 05.1 | 95 | 94.0 | 13.9 | 155 | 153.3 | 22.7 | 215 | 212.7 | 31.6 | 275 | 272.0 | 40.4 |
| 36 | 35.6 | 05.3 | 96 | 95.0 | 14.1 | 156 | 154.3 | 22.9 | 216 | 213.7 | 31.7 | 276 | 273.0 | 40.5 |
| 37 | 36.6 | 05.4 | 97 | 96.0 | 14.2 | 157 | 155.3 | 23.0 | 217 | 214.7 | 31.8 | 277 | 274.0 | 40.6 |
| 38 | 37.6 | 05.6 | 98 | 96.9 | 14.4 | 158 | 156.3 | 23.2 | 218 | 215.6 | 32.0 | 278 | 275.0 | 40.8 |
| 39 | 38.6 | 05.7 | 99 | 97.9 | 14.5 | 159 | 157.3 | 23.3 | 219 | 216.6 | 32.1 | 279 | 276.0 | 40.9 |
| 40 | 39.6 | 05.9 | 100 | 98.9 | 14.7 | 160 | 158.3 | 23.5 | 220 | 217.6 | 32.3 | 280 | 277.0 | 41.1 |
| 41 | 40.6 | 06.0 | 101 | 99.9 | 14.8 | 161 | 159.3 | 23.6 | 221 | 218.6 | 32.4 | 281 | 278.0 | 41.2 |
| 42 | 41.6 | 06.2 | 102 | 100.9 | 15.0 | 162 | 160.3 | 23.8 | 222 | 219.6 | 32.6 | 282 | 279.0 | 41.4 |
| 43 | 42.5 | 06.3 | 103 | 101.9 | 15.1 | 163 | 161.2 | 23.9 | 223 | 220.6 | 32.7 | 283 | 279.9 | 41.5 |
| 44 | 43.5 | 06.5 | 104 | 102.9 | 15.3 | 164 | 162.2 | 24.1 | 224 | 221.6 | 32.9 | 284 | 280.9 | 41.7 |
| 45 | 44.5 | 06.6 | 105 | 103.9 | 15.4 | 165 | 163.2 | 24.2 | 225 | 222.6 | 33.0 | 285 | 281.9 | 41.8 |
| 46 | 45.5 | 06.8 | 106 | 104.9 | 15.6 | 166 | 164.2 | 24.4 | 226 | 223.6 | 33.2 | 286 | 282.9 | 42.0 |
| 47 | 46.5 | 06.9 | 107 | 105.8 | 15.7 | 167 | 165.2 | 24.5 | 227 | 224.5 | 33.3 | 287 | 283.9 | 42.1 |
| 48 | 47.5 | 07.0 | 108 | 106.8 | 15.9 | 168 | 166.2 | 24.7 | 228 | 225.5 | 33.5 | 288 | 284.9 | 42.3 |
| 49 | 48.5 | 07.2 | 109 | 107.8 | 16.0 | 169 | 167.2 | 24.8 | 229 | 226.5 | 33.6 | 289 | 285.9 | 42.4 |
| 50 | 49.5 | 07.3 | 110 | 108.8 | 16.1 | 170 | 168.2 | 24.9 | 230 | 227.5 | 33.8 | 290 | 286.9 | 42.6 |
| 51 | 50.5 | 07.5 | 111 | 109.8 | 16.3 | 171 | 169.2 | 25.1 | 231 | 228.5 | 33.9 | 291 | 287.9 | 42.7 |
| 52 | 51.4 | 07.6 | 112 | 110.8 | 16.4 | 172 | 170.1 | 25.2 | 232 | 229.5 | 34.0 | 292 | 288.8 | 42.9 |
| 53 | 52.4 | 07.8 | 113 | 111.8 | 16.6 | 173 | 171.1 | 25.4 | 233 | 230.5 | 34.2 | 293 | 289.8 | 43.0 |
| 54 | 53.4 | 07.9 | 114 | 112.8 | 16.7 | 174 | 172.1 | 25.5 | 234 | 231.5 | 34.3 | 294 | 290.8 | 43.1 |
| 55 | 54.4 | 08.1 | 115 | 113.8 | 16.9 | 175 | 173.1 | 25.7 | 235 | 232.5 | 34.5 | 295 | 291.8 | 43.3 |
| 56 | 55.4 | 08.2 | 116 | 114.7 | 17.0 | 176 | 174.1 | 25.8 | 236 | 233.4 | 34.6 | 296 | 292.8 | 43.4 |
| 57 | 56.4 | 08.4 | 117 | 115.7 | 17.2 | 177 | 175.1 | 26.0 | 237 | 234.4 | 34.8 | 297 | 293.8 | 43.6 |
| 58 | 57.4 | 08.5 | 118 | 116.7 | 17.3 | 178 | 176.1 | 26.1 | 238 | 235.4 | 34.9 | 298 | 294.8 | 43.7 |
| 59 | 58.4 | 08.7 | 119 | 117.7 | 17.5 | 179 | 177.1 | 26.3 | 239 | 236.4 | 35.1 | 299 | 295.8 | 43.9 |
| 60 | 59.4 | 08.8 | 120 | 118.7 | 17.6 | 180 | 178.1 | 26.4 | 240 | 237.4 | 35.2 | 300 | 296.8 | 44.0 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE I.

## Difference of Latitude and Departure for 1 Point.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 59.8 | 11.9 | 121 | 118.7 | 23.6 | 181 | 177.5 | 35.3 | 241 | 236.4 | 47.0 |
| 2 | 02.0 | 00.4 | 62 | 60.8 | 12.1 | 122 | 119.7 | 23.8 | 182 | 178.5 | 35.5 | 242 | 237.4 | 47.2 |
| 3 | 02.9 | 00.6 | 63 | 61.8 | 12.3 | 123 | 120.6 | 24.0 | 183 | 179.5 | 35.7 | 243 | 238.3 | 47.4 |
| 4 | 03.9 | 00.8 | 64 | 62.8 | 12.5 | 124 | 121.6 | 24.2 | 184 | 180.5 | 35.9 | 244 | 239.3 | 47.6 |
| 5 | 04.9 | 01.0 | 65 | 63.8 | 12.7 | 125 | 122.6 | 24.4 | 185 | 181.5 | 36.1 | 245 | 240.3 | 47.8 |
| 6 | 05.9 | 01.2 | 66 | 64.7 | 12.9 | 126 | 123.6 | 24.6 | 186 | 182.4 | 36.3 | 246 | 241.3 | 48.0 |
| 7 | 06.9 | 01.4 | 67 | 65.7 | 13.1 | 127 | 124.6 | 24.8 | 187 | 183.4 | 36.5 | 247 | 242.3 | 48.2 |
| 8 | 07.8 | 01.6 | 68 | 66.7 | 13.3 | 128 | 125.5 | 25.0 | 188 | 184.4 | 36.7 | 248 | 243.2 | 48.4 |
| 9 | 08.8 | 01.8 | 69 | 67.7 | 13.5 | 129 | 126.5 | 25.2 | 189 | 185.4 | 36.9 | 249 | 244.2 | 48.6 |
| 10 | 09.8 | 02.0 | 70 | 68.7 | 13.7 | 130 | 127.5 | 25.4 | 190 | 186.4 | 37.1 | 250 | 245.2 | 48.8 |
| 11 | 10.8 | 02.2 | 71 | 69.6 | 13.9 | 131 | 128.5 | 25.6 | 191 | 187.3 | 37.3 | 251 | 246.2 | 49.0 |
| 12 | 11.8 | 02.3 | 72 | 70.6 | 14.0 | 132 | 129.5 | 25.8 | 192 | 188.3 | 37.5 | 252 | 247.2 | 49.2 |
| 13 | 12.8 | 02.5 | 73 | 71.6 | 14.2 | 133 | 130.5 | 26.0 | 193 | 189.3 | 37.7 | 253 | 248.1 | 49.4 |
| 14 | 13.7 | 02.7 | 74 | 72.6 | 14.4 | 134 | 131.4 | 26.1 | 194 | 190.3 | 37.8 | 254 | 249.1 | 49.6 |
| 15 | 14.7 | 02.9 | 75 | 73.6 | 14.6 | 135 | 132.4 | 26.3 | 195 | 191.3 | 38.0 | 255 | 250.1 | 49.7 |
| 16 | 15.7 | 03.1 | 76 | 74.5 | 14.8 | 136 | 133.4 | 26.5 | 196 | 192.2 | 38.2 | 256 | 251.1 | 49.9 |
| 17 | 16.7 | 03.3 | 77 | 75.5 | 15.0 | 137 | 134.4 | 26.7 | 197 | 193.2 | 38.4 | 257 | 252.1 | 50.1 |
| 18 | 17.7 | 03.5 | 78 | 76.5 | 15.2 | 138 | 135.4 | 26.9 | 198 | 194.2 | 38.6 | 258 | 253.0 | 50.3 |
| 19 | 18.6 | 03.7 | 79 | 77.5 | 15.4 | 139 | 136.3 | 27.1 | 199 | 195.2 | 38.8 | 259 | 254.0 | 50.5 |
| 20 | 19.6 | 03.9 | 80 | 78.5 | 15.6 | 140 | 137.3 | 27.3 | 200 | 196.2 | 39.0 | 260 | 255.0 | 50.7 |
| 21 | 20.6 | 04.1 | 81 | 79.4 | 15.8 | 141 | 138.3 | 27.5 | 201 | 197.1 | 39.2 | 261 | 256.0 | 50.9 |
| 22 | 21.6 | 04.3 | 82 | 80.4 | 16.0 | 142 | 139.3 | 27.7 | 202 | 198.1 | 39.4 | 262 | 257.0 | 51.1 |
| 23 | 22.6 | 04.5 | 83 | 81.4 | 16.2 | 143 | 140.3 | 27.9 | 203 | 199.1 | 39.6 | 263 | 258.0 | 51.3 |
| 24 | 23.5 | 04.7 | 84 | 82.4 | 16.4 | 144 | 141.2 | 28.1 | 204 | 200.1 | 39.8 | 264 | 258.9 | 51.5 |
| 25 | 24.5 | 04.9 | 85 | 83.4 | 16.6 | 145 | 142.2 | 28.3 | 205 | 201.1 | 40.0 | 265 | 259.9 | 51.7 |
| 26 | 25.5 | 05.1 | 86 | 84.4 | 16.8 | 146 | 143.2 | 28.5 | 206 | 202.0 | 40.2 | 266 | 260.9 | 51.9 |
| 27 | 26.5 | 05.3 | 87 | 85.3 | 17.0 | 147 | 144.2 | 28.7 | 207 | 203.0 | 40.4 | 267 | 261.9 | 52.1 |
| 28 | 27.5 | 05.5 | 88 | 86.3 | 17.2 | 148 | 145.2 | 28.9 | 208 | 204.0 | 40.6 | 268 | 262.9 | 52.3 |
| 29 | 28.4 | 05.7 | 89 | 87.3 | 17.4 | 149 | 146.1 | 29.1 | 209 | 205.0 | 40.8 | 269 | 263.8 | 52.5 |
| 30 | 29.4 | 05.9 | 90 | 88.3 | 17.6 | 150 | 147.1 | 29.3 | 210 | 206.0 | 41.0 | 270 | 264.8 | 52.7 |
| 31 | 30.4 | 06.0 | 91 | 89.3 | 17.8 | 151 | 148.1 | 29.5 | 211 | 207.0 | 41.2 | 271 | 265.8 | 52.9 |
| 32 | 31.4 | 06.2 | 92 | 90.2 | 18 0 | 152 | 149.1 | 29.7 | 212 | 207.9 | 41.4 | 272 | 266.8 | 53.1 |
| 33 | 32.4 | 06.4 | 93 | 91.2 | 18.1 | 153 | 150.1 | 29.9 | 213 | 208.9 | 41.6 | 273 | 267.8 | 53.3 |
| 34 | 33.4 | 06.6 | 94 | 92.2 | 18.3 | 154 | 151.0 | 30.0 | 214 | 209.9 | 41.8 | 274 | 268.7 | 53.5 |
| 35 | 34.3 | 06.8 | 95 | 93.2 | 18.5 | 155 | 152.0 | 30.2 | 215 | 210.9 | 41.9 | 275 | 269.7 | 53.6 |
| 36 | 35.3 | 07.0 | 96 | 94.2 | 18.7 | 156 | 153.0 | 30.4 | 216 | 211.9 | 42.1 | 276 | 270.7 | 53.8 |
| 37 | 36.3 | 07.2 | 97 | 95.1 | 18.9 | 157 | 154.0 | 30.6 | 217 | 212.8 | 42.3 | 277 | 271.7 | 54.0 |
| 38 | 37.3 | 07.4 | 98 | 96.1 | 19.1 | 158 | 155.0 | 30.8 | 218 | 213.8 | 42.5 | 278 | 272.7 | 54.2 |
| 39 | 38.3 | 07.6 | 99 | 97.1 | 19.3 | 159 | 156.0 | 31.0 | 219 | 214.8 | 42.7 | 279 | 273.6 | 54.4 |
| 40 | 39.2 | 07.8 | 100 | 98.1 | 19.5 | 160 | 156.9 | 31.2 | 220 | 215.8 | 42.9 | 280 | 274.6 | 54.6 |
| 41 | 40.2 | 08.0 | 101 | 99.1 | 19.7 | 161 | 157.9 | 31.4 | 221 | 216.8 | 43.1 | 281 | 275.6 | 54.8 |
| 42 | 41.2 | 08.2 | 102 | 100.0 | 19.9 | 162 | 158.9 | 31.6 | 222 | 217.7 | 43.3 | 282 | 276.6 | 55.0 |
| 43 | 42.2 | 08.4 | 103 | 101.0 | 20.1 | 163 | 159.9 | 31.8 | 223 | 218.7 | 43.5 | 283 | 277.6 | 55.2 |
| 44 | 43.2 | 08.6 | 104 | 102.0 | 20.3 | 164 | 160.9 | 32.0 | 224 | 219.7 | 43.7 | 284 | 278.5 | 55.4 |
| 45 | 44.1 | 08.8 | 105 | 103.0 | 20.5 | 165 | 161.8 | 32.2 | 225 | 220.7 | 43.9 | 285 | 279.5 | 55.6 |
| 46 | 45.1 | 09.0 | 106 | 104.0 | 20.7 | 166 | 162.8 | 32.4 | 226 | 221.7 | 44.1 | 286 | 280.5 | 55.8 |
| 47 | 46.1 | 09.2 | 107 | 104.9 | 20.9 | 167 | 163.8 | 32.6 | 227 | 222.6 | 44.3 | 287 | 281.5 | 56.0 |
| 48 | 47.1 | 09.4 | 108 | 105.9 | 21.1 | 168 | 164.8 | 32.8 | 228 | 223.6 | 44.5 | 288 | 282.5 | 56.2 |
| 49 | 48.1 | 09.6 | 109 | 106.9 | 21.3 | 169 | 165.8 | 33.0 | 229 | 224.6 | 44.7 | 289 | 283.5 | 56.4 |
| 50 | 49.0 | 09.8 | 110 | 107.9 | 21.5 | 170 | 166.7 | 33.2 | 230 | 225.6 | 44.9 | 290 | 284.4 | 56.6 |
| 51 | 50.0 | 10.0 | 111 | 108.9 | 21.7 | 171 | 167.7 | 33.4 | 231 | 226.6 | 45.1 | 291 | 285.4 | 56.8 |
| 52 | 51.0 | 10.1 | 112 | 109.9 | 21.9 | 172 | 168.7 | 33.6 | 232 | 227.5 | 45.3 | 292 | 286.4 | 57.0 |
| 53 | 52.0 | 10.3 | 113 | 110.8 | 22.0 | 173 | 169.7 | 33.8 | 233 | 228.5 | 45.5 | 293 | 287.4 | 57.2 |
| 54 | 53.0 | 10.5 | 114 | 111.8 | 22.2 | 174 | 170.7 | 34.0 | 234 | 229.5 | 45.7 | 294 | 288.4 | 57.4 |
| 55 | 53.9 | 10.7 | 115 | 112.8 | 22.4 | 175 | 171.6 | 34.1 | 235 | 230.5 | 45.9 | 295 | 289.3 | 57.6 |
| 56 | 54.9 | 10.9 | 116 | 113.8 | 22.6 | 176 | 172.6 | 34.3 | 236 | 231.5 | 46.0 | 296 | 290.3 | 57.7 |
| 57 | 55.9 | 11.1 | 117 | 114.8 | 22.8 | 177 | 173.6 | 34.5 | 237 | 232.5 | 46.2 | 297 | 291.3 | 57.9 |
| 58 | 56.9 | 11.3 | 118 | 115.7 | 23.0 | 178 | 174.6 | 34.7 | 238 | 233.4 | 46.4 | 298 | 292.3 | 58.1 |
| 59 | 57.9 | 11.5 | 119 | 116.7 | 23.2 | 179 | 175.6 | 34.9 | 239 | 234.4 | 46.6 | 299 | 293.3 | 58.3 |
| 60 | 58.8 | 11.7 | 120 | 117.7 | 23.4 | 180 | 176.5 | 35.1 | 240 | 235.4 | 46.8 | 300 | 294.2 | 58.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |



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# TABLE I.

## Difference of Latitude and Departure for 1 ¼ Point.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 59.2 | 14.8 | 121 | 117.4 | 29.4 | 181 | 175.6 | 44.0 | 241 | 233.8 | 58.6 |
| 2 | 01.9 | 00.5 | 62 | 60.1 | 15.1 | 122 | 118.4 | 29.6 | 182 | 176.5 | 44.2 | 242 | 234.8 | 58.8 |
| 3 | 02.9 | 00.7 | 63 | 61.1 | 15.3 | 123 | 119.3 | 29.9 | 183 | 177.5 | 44.5 | 243 | 235.7 | 59.0 |
| 4 | 03 9 | 01.0 | 64 | 62.1 | 15.6 | 124 | 120.3 | 30.1 | 184 | 178.5 | 44.7 | 244 | 236.7 | 59.3 |
| 5 | 04.9 | 01.2 | 65 | 63.1 | 15.8 | 125 | 121.3 | 30.4 | 185 | 179.5 | 45.0 | 245 | 237.7 | 59.5 |
| 6 | 05.8 | 01.5 | 66 | 64.0 | 16.0 | 126 | 122.2 | 30.6 | 186 | 180.4 | 45.2 | 246 | 238.6 | 59.8 |
| 7 | 06.8 | 01.7 | 67 | 65.0 | 16.3 | 127 | 123.2 | 30.9 | 187 | 181.4 | 45.4 | 247 | 239.6 | 60.0 |
| 8 | 07.8 | 01.9 | 68 | 66.0 | 16.5 | 128 | 124.2 | 31.1 | 188 | 182.4 | 45.7 | 248 | 240.6 | 60.3 |
| 9 | 08.7 | 02.2 | 69 | 66.9 | 16.8 | 129 | 125.1 | 31.3 | 189 | 183.3 | 45.9 | 249 | 241.6 | 60.5 |
| 10 | 09.7 | 02.4 | 70 | 67.9 | 17.0 | 130 | 126.1 | 31.6 | 190 | 184.3 | 46.2 | 250 | 242.5 | 60.8 |
| 11 | 10.7 | 02.7 | 71 | 68.9 | 17.3 | 131 | 127.1 | 31.8 | 191 | 185.3 | 46.4 | 251 | 243.5 | 61.0 |
| 12 | 11.6 | 02.9 | 72 | 69.9 | 17.5 | 132 | 128.1 | 32.1 | 192 | 186.2 | 46.7 | 252 | 244.5 | 61.2 |
| 13 | 12.6 | 03.2 | 73 | 70.8 | 17.7 | 133 | 129.0 | 32.3 | 193 | 187.2 | 46.9 | 253 | 245.4 | 61.5 |
| 14 | 13.6 | 03.4 | 74 | 71.8 | 18.0 | 134 | 130.0 | 32.6 | 194 | 188.2 | 47.1 | 254 | 246.4 | 61.7 |
| 15 | 14.6 | 03.6 | 75 | 72.8 | 18.2 | 135 | 131.0 | 32.8 | 195 | 189.2 | 47.4 | 255 | 247.4 | 62.0 |
| 16 | 15.5 | 03.9 | 76 | 73.7 | 18.5 | 136 | 131.9 | 33.1 | 196 | 190.1 | 47.6 | 256 | 248.3 | 62.2 |
| 17 | 16.5 | 04.1 | 77 | 74.7 | 18.7 | 137 | 132.9 | 33.3 | 197 | 191.1 | 47.9 | 257 | 249.3 | 62.5 |
| 18 | 17.5 | 04.4 | 78 | 75.7 | 19.0 | 138 | 133.9 | 33.5 | 198 | 192.1 | 48.1 | 258 | 250.3 | 62.7 |
| 19 | 18.4 | 04.6 | 79 | 76.6 | 19.2 | 139 | 134.8 | 33.8 | 199 | 193.0 | 48.4 | 259 | 251.3 | 62.9 |
| 20 | 19.4 | 04.9 | 80 | 77.6 | 19.4 | 140 | 135.8 | 34.0 | 200 | 194.0 | 48.6 | 260 | 252.2 | 63.2 |
| 21 | 20.4 | 05.1 | 81 | 78.6 | 19.7 | 141 | 136.8 | 34.3 | 201 | 195.0 | 48.8 | 261 | 253.2 | 63.4 |
| 22 | 21.3 | 05.4 | 82 | 79.6 | 19.9 | 142 | 137.8 | 34.5 | 202 | 196.0 | 49.1 | 262 | 254.2 | 63.7 |
| 23 | 22.3 | 05.6 | 83 | 80.5 | 20.2 | 143 | 138.7 | 34.8 | 203 | 196.9 | 49.3 | 263 | 255.1 | 63.9 |
| 24 | 23.3 | 05.8 | 84 | 81.5 | 20.4 | 144 | 139.7 | 35.0 | 204 | 197.9 | 49.6 | 264 | 256.1 | 64.2 |
| 25 | 24.3 | 06.1 | 85 | 82.5 | 20.7 | 145 | 140·7 | 35.2 | 205 | 198.9 | 49.8 | 265 | 257.1 | 64.4 |
| 26 | 25.2 | 06.3 | 86 | 83.4 | 20.9 | 146 | 141.6 | 35.5 | 206 | 199.8 | 50.1 | 266 | 258.0 | 64.6 |
| 27 | 26.2 | 06.6 | 87 | 84.4 | 21.1 | 147 | 142.6 | 35.7 | 207 | 200.8 | 50.3 | 267 | 259.0 | 64.9 |
| 28 | 27.2 | 06.8 | 88 | 85.4 | 21.4 | 148 | 143.6 | 36.0 | 208 | 201.8 | 50.5 | 268 | 260.0 | 65.1 |
| 29 | 28.1 | 07.1 | 89 | 86.3 | 21.6 | 149 | 144.5 | 36.2 | 209 | 202.7 | 50.8 | 269 | 261.0 | 65.4 |
| 30 | 29.1 | 07.3 | 90 | 87.3 | 21.9 | 150 | 145.5 | 36.5 | 210 | 203.7 | 51.0 | 270 | 261.9 | 65.6 |
| 31 | 30.1 | 07.5 | 91 | 88.3 | 22.1 | 151 | 146.5 | 36.7 | 211 | 204.7 | 51.3 | 271 | 262.9 | 65.9 |
| 32 | 31.0 | 07.8 | 92 | 89.3 | 22.4 | 152 | 147.4 | 36.9 | 212 | 205.7 | 51.5 | 272 | 263.9 | 66.1 |
| 33 | 32.0 | 08.0 | 93 | 90.2 | 22.6 | 153 | 148.4 | 37.2 | 213 | 206.6 | 51.8 | 273 | 264.8 | 66.3 |
| 34 | 33.0 | 08.3 | 94 | 91.2 | 22.8 | 154 | 149.4 | 37.4 | 214 | 207.6 | 52.0 | 274 | 265.8 | 66.6 |
| 35 | 34.0 | 08.5 | 95 | 92.2 | 23.1 | 155 | 150.4 | 37.7 | 215 | 208.6 | 52.2 | 275 | 266.8 | 66.8 |
| 36 | 34.9 | 08.8 | 96 | 93.1 | 23.3 | 156 | 151.3 | 37.9 | 216 | 209.5 | 52.5 | 276 | 267.7 | 67.1 |
| 37 | 35.9 | 09.0 | 97 | 94.1 | 23.6 | 157 | 152.3 | 38.2 | 217 | 210.5 | 52.7 | 277 | 268.7 | 67.3 |
| 38 | 36.9 | 09.2 | 98 | 95.1 | 23.8 | 158 | 153.3 | 38.4 | 218 | 211.5 | 53.0 | 278 | 269.7 | 67.6 |
| 39 | 37.8 | 09.5 | 99 | 96.0 | 24.1 | 159 | 154.2 | 38.6 | 219 | 212.5 | 53.2 | 279 | 270.7 | 67.8 |
| 40 | 38.8 | 09.7 | 100 | 97.0 | 24.3 | 160 | 155.2 | 38.9 | 220 | 213.4 | 53.5 | 280 | 271.6 | 68.0 |
| 41 | 39.8 | 10.0 | 101 | 98.0 | 24.5 | 161 | 156.2 | 39.1 | 221 | 214.4 | 53.7 | 281 | 272.6 | 68.3 |
| 42 | 40.7 | 10.2 | 102 | 99.0 | 24.8 | 162 | 157.2 | 39.4 | 222 | 215.4 | 53.9 | 282 | 273.6 | 68.5 |
| 43 | 41.7 | 10.5 | 103 | 99.9 | 25.0 | 163 | 158.1 | 39.6 | 223 | 216.3 | 54.2 | 283 | 274.5 | 68.8 |
| 44 | 42.7 | 10.7 | 104 | 100.9 | 25.3 | 164 | 159.1 | 39.9 | 224 | 217.3 | 54.4 | 284 | 275.5 | 69.0 |
| 45 | 43.7 | 10.9 | 105 | 101.9 | 25.5 | 165 | 160.1 | 40.1 | 225 | 218.3 | 54.7 | 285 | 276.5 | 69.3 |
| 46 | 44.6 | 11.2 | 106 | 102.8 | 25.8 | 166 | 161.0 | 40.3 | 226 | 219.2 | 54.9 | 286 | 277.4 | 69.5 |
| 47 | 45.6 | 11.4 | 107 | 103.8 | 26.0 | 167 | 162.0 | 40.6 | 227 | 220.2 | 55.2 | 287 | 278.4 | 69.7 |
| 48 | 46.6 | 11.7 | 108 | 104.8 | 26.2 | 168 | 163.0 | 40.8 | 228 | 221.2 | 55.4 | 288 | 279.4 | 70.0 |
| 49 | 47.5 | 11.9 | 109 | 105.7 | 26.5 | 169 | 163.9 | 41.1 | 229 | 222.2 | 55.6 | 289 | 280.4 | 70.2 |
| 50 | 48.5 | 12.2 | 110 | 106.7 | 26.7 | 170 | 164.9 | 41.3 | 230 | 223.1 | 55.9 | 290 | 281.3 | 70.5 |
| 51 | 49.5 | 12.4 | 111 | 107.7 | 27.0 | 171 | 165.9 | 41.6 | 231 | 224.1 | 56.1 | 291 | 282.3 | 70.7 |
| 52 | 50.4 | 12.6 | 112 | 108.7 | 27.2 | 172 | 166.9 | 41.8 | 232 | 225.1 | 56.4 | 292 | 283.3 | 71.0 |
| 53 | 51.4 | 12.9 | 113 | 109.6 | 27.5 | 173 | 167.8 | 42.0 | 233 | 226.0 | 56.6 | 293 | 284.2 | 71.2 |
| 54 | 52.4 | 13.1 | 114 | 110.6 | 27.7 | 174 | 168.8 | 42.3 | 234 | 227.0 | 56.9 | 294 | 285.2 | 71.4 |
| 55 | 53.4 | 13.4 | 115 | 111.6 | 27.9 | 175 | 169.8 | 42.5 | 235 | 228.0 | 57.1 | 295 | 286.2 | 71.7 |
| 56 | 54.3 | 13.6 | 116 | 112.5 | 28.2 | 176 | 170.7 | 42.8 | 236 | 228.9 | 57.3 | 296 | 287.1 | 71.9 |
| 57 | 55.3 | 13.9 | 117 | 113.5 | 28.4 | 177 | 171.7 | 43.0 | 237 | 229.9 | 57.6 | 297 | 288.1 | 72.2 |
| 58 | 56.3 | 14.1 | 118 | 114.5 | 28.7 | 178 | 172.7 | 43.3 | 238 | 230.9 | 57.8 | 298 | 289.1 | 72.4 |
| 59 | 57.2 | 14.3 | 119 | 115.4 | 28.9 | 179 | 173.6 | 43.5 | 239 | 231.8 | 58 1 | 299 | 290.1 | 72.7 |
| 60 | 58.2 | 14.6 | 120 | 116.4 | 29.2 | 180 | 174.6 | 43.7 | 240 | 232.8 | 58.3 | 300 | 291.0 | 72.9 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE I.

## Difference of Latitude and Departure for 1 ½ Point.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.3 | 61 | 58.4 | 17.7 | 121 | 115.8 | 35.1 | 181 | 173.2 | 52.5 | 241 | 230.6 | 70.0 |
| 2 | 01.9 | 00.6 | 62 | 59.3 | 18.0 | 122 | 116.8 | 35.4 | 182 | 174.2 | 52.8 | 242 | 231.6 | 70.3 |
| 3 | 02.9 | 00.9 | 63 | 60.3 | 18.3 | 123 | 117.7 | 35.7 | 183 | 175.1 | 53.1 | 243 | 232.5 | 70.5 |
| 4 | 03.8 | 01.2 | 64 | 61.2 | 18.6 | 124 | 118.7 | 36.0 | 184 | 176.1 | 53.4 | 244 | 233.5 | 70.8 |
| 5 | 04.8 | 01.5 | 65 | 62.2 | 18.9 | 125 | 119.6 | 36.3 | 185 | 177.0 | 53.7 | 245 | 234.5 | 71.1 |
| 6 | 05.7 | 01.7 | 66 | 63.2 | 19.2 | 126 | 120.6 | 36.6 | 186 | 178.0 | 54.0 | 246 | 235.4 | 71.4 |
| 7 | 06.7 | 02.0 | 67 | 64.1 | 19.5 | 127 | 121.5 | 36.9 | 187 | 179.0 | 54.3 | 247 | 236.4 | 71.7 |
| 8 | 07.7 | 02.3 | 68 | 65.1 | 19.7 | 128 | 122.5 | 37.2 | 188 | 179.9 | 54.6 | 248 | 237.3 | 72.0 |
| 9 | 08.6 | 02.6 | 69 | 66.0 | 20.0 | 129 | 123.5 | 37.5 | 189 | 180.9 | 54.9 | 249 | 238.3 | 72.3 |
| 10 | 09.6 | 02.9 | 70 | 67.0 | 20.3 | 130 | 124.4 | 37.7 | 190 | 181.8 | 55.2 | 250 | 239.2 | 72.6 |
| 11 | 10.5 | 03.2 | 71 | 67.9 | 20.6 | 131 | 125.4 | 38.0 | 191 | 182.8 | 55.4 | 251 | 240.2 | 72.9 |
| 12 | 11.5 | 03.5 | 72 | 68.9 | 20.9 | 132 | 126.3 | 38.3 | 192 | 183.7 | 55.7 | 252 | 241.2 | 73.2 |
| 13 | 12.4 | 03.8 | 73 | 69.9 | 21.2 | 133 | 127.3 | 38.6 | 193 | 184.7 | 56.0 | 253 | 242.1 | 73.4 |
| 14 | 13.4 | 04.1 | 74 | 70.8 | 21.5 | 134 | 128.2 | 38.9 | 194 | 185.7 | 56.3 | 254 | 243.1 | 73.7 |
| 15 | 14.4 | 04.4 | 75 | 71.8 | 21.8 | 135 | 129.2 | 39.2 | 195 | 186.6 | 56.6 | 255 | 244.0 | 74.0 |
| 16 | 15.3 | 04.6 | 76 | 72.7 | 22.1 | 136 | 130.1 | 39.5 | 196 | 187.6 | 56.9 | 256 | 245.0 | 74.3 |
| 17 | 16.3 | 04.9 | 77 | 73.7 | 22.4 | 137 | 131.1 | 39.8 | 197 | 188.5 | 57.2 | 257 | 245.9 | 74.6 |
| 18 | 17.2 | 05.2 | 78 | 74.6 | 22.6 | 138 | 132.1 | 40.1 | 198 | 189.5 | 57.5 | 258 | 246.9 | 74.9 |
| 19 | 18.2 | 05.5 | 79 | 75.6 | 22.9 | 139 | 133.0 | 40.4 | 199 | 190.4 | 57.8 | 259 | 247.9 | 75.2 |
| 20 | 19.1 | 05.8 | 80 | 76.6 | 23.2 | 140 | 134.0 | 40.6 | 200 | 191.4 | 58.1 | 260 | 248.8 | 75.5 |
| 21 | 20.1 | 06.1 | 81 | 77.5 | 23.5 | 141 | 134.9 | 40.9 | 201 | 192.3 | 58.4 | 261 | 249.8 | 75.8 |
| 22 | 21.1 | 06.4 | 82 | 78.5 | 23.8 | 142 | 135.9 | 41.2 | 202 | 193.3 | 58.6 | 262 | 250.7 | 76.1 |
| 23 | 22.0 | 06.7 | 83 | 79.4 | 24.1 | 143 | 136.8 | 41.5 | 203 | 194.3 | 58.9 | 263 | 251.7 | 76.3 |
| 24 | 23.0 | 07.0 | 84 | 80.4 | 24.4 | 144 | 137.8 | 41.8 | 204 | 195.2 | 59.2 | 264 | 252.6 | 76.6 |
| 25 | 23.9 | 07.3 | 85 | 81.3 | 24.7 | 145 | 138.8 | 42.1 | 205 | 196.2 | 59.5 | 265 | 253.6 | 76.9 |
| 26 | 24.9 | 07.6 | 86 | 82.3 | 25.0 | 146 | 139.7 | 42.4 | 206 | 197.1 | 59.8 | 266 | 254.6 | 77.2 |
| 27 | 25.8 | 07.8 | 87 | 83.3 | 25.3 | 147 | 140.7 | 42.7 | 207 | 198.1 | 60.1 | 267 | 255.5 | 77.5 |
| 28 | 26.8 | 08.1 | 88 | 84.2 | 25.5 | 148 | 141.6 | 43.0 | 208 | 199.0 | 60.4 | 268 | 256.5 | 77.8 |
| 29 | 27.8 | 08.4 | 89 | 85.2 | 25.8 | 149 | 142.6 | 43.3 | 209 | 200.0 | 60.7 | 269 | 257.4 | 78.1 |
| 30 | 28.7 | 08.7 | 90 | 86.1 | 26.1 | 150 | 143.5 | 43.5 | 210 | 201.0 | 61.0 | 270 | 258.4 | 78.4 |
| 31 | 29.7 | 09.0 | 91 | 87.1 | 26.4 | 151 | 144.5 | 43.8 | 211 | 201.9 | 61.3 | 271 | 259.3 | 78.7 |
| 32 | 30.6 | 09.3 | 92 | 88.0 | 26.7 | 152 | 145.5 | 44.1 | 212 | 202.9 | 61.5 | 272 | 260.3 | 79.0 |
| 33 | 31.6 | 09.6 | 93 | 89.0 | 27.0 | 153 | 146.4 | 44.4 | 213 | 203.8 | 61.8 | 273 | 261.2 | 79.3 |
| 34 | 32.5 | 09.9 | 94 | 90.0 | 27.3 | 154 | 147.4 | 44.7 | 214 | 204.8 | 62.1 | 274 | 262.2 | 79.5 |
| 35 | 33.5 | 10.2 | 95 | 90.9 | 27.6 | 155 | 148.3 | 45.0 | 215 | 205.7 | 62.4 | 275 | 263.2 | 79.8 |
| 36 | 34.5 | 10.5 | 96 | 91.9 | 27.9 | 156 | 149.3 | 45.3 | 216 | 206.7 | 62.7 | 276 | 264.1 | 80.1 |
| 37 | 35.4 | 10.7 | 97 | 92.8 | 28.2 | 157 | 150.2 | 45.6 | 217 | 207.7 | 63.0 | 277 | 265.1 | 80.4 |
| 38 | 36.4 | 11.0 | 98 | 93.8 | 28.5 | 158 | 151.2 | 45.9 | 218 | 208.6 | 63.3 | 278 | 266.0 | 80.7 |
| 39 | 37.3 | 11.3 | 99 | 94.7 | 28.7 | 159 | 152.2 | 46.2 | 219 | 209.6 | 63.6 | 279 | 267.0 | 81.0 |
| 40 | 38.3 | 11.6 | 100 | 95.7 | 29.0 | 160 | 153.1 | 46.4 | 220 | 210.5 | 63.9 | 280 | 267.9 | 81.3 |
| 41 | 39.2 | 11.9 | 101 | 96.7 | 29.3 | 161 | 154.1 | 46.7 | 221 | 211.5 | 64.2 | 281 | 268.9 | 81.6 |
| 42 | 40.2 | 12.2 | 102 | 97.6 | 29.6 | 162 | 155.0 | 47.0 | 222 | 212.4 | 64.4 | 282 | 269.9 | 81.9 |
| 43 | 41.2 | 12.5 | 103 | 98.6 | 29.9 | 163 | 156.0 | 47.3 | 223 | 213.4 | 64.7 | 283 | 270.8 | 82.2 |
| 44 | 42.1 | 12.8 | 104 | 99.5 | 30.2 | 164 | 156.9 | 47.6 | 224 | 214.4 | 65.0 | 284 | 271.8 | 82.4 |
| 45 | 43.1 | 13.1 | 105 | 100.5 | 30.5 | 165 | 157.9 | 47.9 | 225 | 215.3 | 65.3 | 285 | 272.7 | 82.7 |
| 46 | 44.0 | 13.4 | 106 | 101.4 | 30.8 | 166 | 158.9 | 48.2 | 226 | 216.3 | 65.6 | 286 | 273.7 | 83.0 |
| 47 | 45.0 | 13.6 | 107 | 102.4 | 31.1 | 167 | 159.8 | 48.5 | 227 | 217.2 | 65.9 | 287 | 274.6 | 83.3 |
| 48 | 45.9 | 13.9 | 108 | 103.4 | 31.4 | 168 | 160.8 | 48.8 | 228 | 218.2 | 66.2 | 288 | 275.6 | 83.6 |
| 49 | 46.9 | 14.2 | 109 | 104.3 | 31.6 | 169 | 161.7 | 49.1 | 229 | 219.1 | 66.5 | 289 | 276.6 | 83.9 |
| 50 | 47.9 | 14.5 | 110 | 105.3 | 31.9 | 170 | 162.7 | 49.4 | 230 | 220.1 | 66.8 | 290 | 277.5 | 84.2 |
| 51 | 48.8 | 14.8 | 111 | 106.2 | 32.2 | 171 | 163.6 | 49.6 | 231 | 221.1 | 67.1 | 291 | 278.5 | 84.5 |
| 52 | 49.8 | 15.1 | 112 | 107.2 | 32.5 | 172 | 164.6 | 49.9 | 232 | 222.0 | 67.3 | 292 | 279.4 | 84.8 |
| 53 | 50.7 | 15.4 | 113 | 108.1 | 32.8 | 173 | 165.6 | 50.2 | 233 | 223.0 | 67.6 | 293 | 280.4 | 85.0 |
| 54 | 51.7 | 15.7 | 114 | 109.1 | 33.1 | 174 | 166.5 | 50.5 | 234 | 223.9 | 67.9 | 294 | 281.3 | 85.3 |
| 55 | 52.6 | 16.0 | 115 | 110.1 | 33.4 | 175 | 167.5 | 50.8 | 235 | 224.9 | 68.2 | 295 | 282.3 | 85.6 |
| 56 | 53.6 | 16.3 | 116 | 111.0 | 33.7 | 176 | 168.4 | 51.1 | 236 | 225.8 | 68.5 | 296 | 283.3 | 85.9 |
| 57 | 54.6 | 16.6 | 117 | 112.0 | 34.0 | 177 | 169.4 | 51.4 | 237 | 226.8 | 68.8 | 297 | 284.2 | 86.2 |
| 58 | 55.5 | 16.8 | 118 | 112.9 | 34.3 | 178 | 170.3 | 51.7 | 238 | 227.8 | 69.1 | 298 | 285.2 | 86.5 |
| 59 | 56.5 | 17.1 | 119 | 113.9 | 34.5 | 179 | 171.3 | 52.0 | 239 | 228.7 | 69.4 | 299 | 286.1 | 86.8 |
| 60 | 57.4 | 17.4 | 120 | 114.8 | 34.8 | 180 | 172.3 | 52.3 | 240 | 229.7 | 69.7 | 300 | 287.1 | 87.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 6 ½ Points.

# TABLE I.

## Difference of Latitude and Departure for 1¾ Point.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.3 | 61 | 57.4 | 20.6 | 121 | 113.9 | 40.8 | 181 | 170.4 | 61.0 | 241 | 226.9 | 81.2 |
| 2 | 01.9 | 00.7 | 62 | 58.4 | 20.9 | 122 | 114.9 | 41.1 | 182 | 171.4 | 61.3 | 242 | 227.9 | 81.5 |
| 3 | 02.8 | 01.0 | 63 | 59.3 | 21.2 | 123 | 115.8 | 41.4 | 183 | 172.3 | 61.7 | 243 | 228.8 | 81.9 |
| 4 | 03.8 | 01.4 | 64 | 60.3 | 21.6 | 124 | 116.8 | 41.8 | 184 | 173.2 | 62.0 | 244 | 229.7 | 82.2 |
| 5 | 04.7 | 01.7 | 65 | 61.2 | 21.9 | 125 | 117.7 | 42.1 | 185 | 174.2 | 62.3 | 245 | 230.7 | 82.5 |
| 6 | 05.7 | 02.0 | 66 | 62.1 | 22.2 | 126 | 118.6 | 42.5 | 186 | 175.1 | 62.7 | 246 | 231.6 | 82.9 |
| 7 | 06.6 | 02.4 | 67 | 63.1 | 22.6 | 127 | 119.6 | 42.8 | 187 | 176.1 | 63.0 | 247 | 232.6 | 83.2 |
| 8 | 07.5 | 02.7 | 68 | 64.0 | 22.9 | 128 | 120.5 | 43.1 | 188 | 177.0 | 63.3 | 248 | 233.5 | 83.6 |
| 9 | 08.5 | 03.0 | 69 | 65.0 | 23.3 | 129 | 121.5 | 43.5 | 189 | 177.9 | 63.7 | 249 | 234.4 | 83.9 |
| 10 | 09.4 | 03.4 | 70 | 65.9 | 23.6 | 130 | 122.4 | 43.8 | 190 | 178.9 | 64.0 | 250 | 235.4 | 84.2 |
| 11 | 10.4 | 03.7 | 71 | 66.9 | 23.9 | 131 | 123.3 | 44.1 | 191 | 179 8 | 64.4 | 251 | 236.3 | 84.6 |
| 12 | 11.3 | 04.0 | 72 | 67.8 | 24.3 | 132 | 124.3 | 44.5 | 192 | 180.8 | 64.7 | 252 | 237.3 | 84.9 |
| 13 | 12.2 | 04.4 | 73 | 68.7 | 24.6 | 133 | 125.2 | 44.8 | 193 | 181.7 | 65.0 | 253 | 238.2 | 85.2 |
| 14 | 13.2 | 04.7 | 74 | 69.7 | 24.9 | 134 | 126.2 | 45.1 | 194 | 182.7 | 65.4 | 254 | 239.1 | 85.6 |
| 15 | 14.1 | 05.1 | 75 | 70.6 | 25.3 | 135 | 127.1 | 45.5 | 195 | 183.6 | 65.7 | 255 | 240.1 | 85.9 |
| 16 | 15.1 | 05.4 | 76 | 71.6 | 25.6 | 136 | 128.1 | 45.8 | 196 | 184.5 | 66.0 | 256 | 241.0 | 86.2 |
| 17 | 16.0 | 05.7 | 77 | 72.5 | 25.9 | 137 | 129.0 | 46.2 | 197 | 185.5 | 66.4 | 257 | 242.0 | 86.6 |
| 18 | 17.0 | 06.1 | 78 | 73.4 | 26.3 | 138 | 129.9 | 46.5 | 198 | 186.4 | 66.7 | 258 | 242.9 | 86.9 |
| 19 | 17.9 | 06.4 | 79 | 74.4 | 26.6 | 139 | 130.9 | 46.8 | 199 | 187.4 | 67.0 | 259 | 243.9 | 87.3 |
| 20 | 18.8 | 06.7 | 80 | 75.3 | 27.0 | 140 | 131.8 | 47.2 | 200 | 188.3 | 67.4 | 260 | 244.8 | 87.6 |
| 21 | 19.8 | 07.1 | 81 | 76.3 | 27.3 | 141 | 132.8 | 47.5 | 201 | 189.3 | 67.7 | 261 | 245.7 | 87.9 |
| 22 | 20.7 | 07.4 | 82 | 77.2 | 27.6 | 142 | 133.7 | 47.8 | 202 | 190.2 | 68.1 | 262 | 246.7 | 88.3 |
| 23 | 21.7 | 07.8 | 83 | 78.2 | 28.0 | 143 | 134.6 | 48.2 | 203 | 191.1 | 68.4 | 263 | 247.6 | 88.6 |
| 24 | 22.6 | 08.1 | 84 | 79.1 | 28.3 | 144 | 135.6 | 48.5 | 204 | 192.1 | 68.7 | 264 | 248.6 | 88.9 |
| 25 | 23.5 | 08.4 | 85 | 80.0 | 28.6 | 145 | 136.5 | 48.9 | 205 | 193.0 | 69.1 | 265 | 249.5 | 89.3 |
| 26 | 24.5 | 08.8 | 86 | 81.0 | 29.0 | 146 | 137.5 | 49.2 | 206 | 194.0 | 69.4 | 266 | 250.5 | 89.6 |
| 27 | 25.4 | 09.1 | 87 | 81.9 | 29.3 | 147 | 138.4 | 49.5 | 207 | 194.9 | 69.7 | 267 | 251.4 | 90.0 |
| 28 | 26.4 | 09.4 | 88 | 82.9 | 29.7 | 148 | 139.4 | 49.9 | 208 | 195.8 | 70.1 | 268 | 252.3 | 90.3 |
| 29 | 27.3 | 09.8 | 89 | 83.8 | 30.0 | 149 | 140.3 | 50.2 | 209 | 196.8 | 70.4 | 269 | 253.3 | 90.6 |
| 30 | 28.3 | 10.1 | 90 | 84.7 | 30.3 | 150 | 141.2 | 50.5 | 210 | 197.7 | 70.8 | 270 | 254.2 | 91.0 |
| 31 | 29.2 | 10.4 | 91 | 85.7 | 30.7 | 151 | 142.2 | 50.9 | 211 | 198.7 | 71.1 | 271 | 255.2 | 91.3 |
| 32 | 30.1 | 10.8 | 92 | 86.6 | 31.0 | 152 | 143.1 | 51.2 | 212 | 199.6 | 71.4 | 272 | 256.1 | 91.6 |
| 33 | 31.1 | 11.1 | 93 | 87.6 | 31.3 | 153 | 144.1 | 51.5 | 213 | 200.6 | 71.8 | 273 | 257.0 | 92.0 |
| 34 | 32.0 | 11.5 | 94 | 88.5 | 31.7 | 154 | 145.0 | 51.9 | 214 | 201.5 | 72.1 | 274 | 258.0 | 92.3 |
| 35 | 33.0 | 11.8 | 95 | 89.5 | 32.0 | 155 | 145.9 | 52.2 | 215 | 202.4 | 72.4 | 275 | 258.9 | 92.6 |
| 36 | 33.9 | 12.1 | 96 | 90.4 | 32.3 | 156 | 146.9 | 52.6 | 216 | 203.4 | 72.8 | 276 | 259.9 | 93.0 |
| 37 | 34.8 | 12.5 | 97 | 91.3 | 32.7 | 157 | 147.8 | 52.9 | 217 | 204.3 | 73.1 | 277 | 260.8 | 93.3 |
| 38 | 35.8 | 12.8 | 98 | 92.3 | 33.0 | 158 | 148.8 | 53.2 | 218 | 205.3 | 73.4 | 278 | 261.8 | 93.7 |
| 39 | 36.7 | 13.1 | 99 | 93.2 | 33.4 | 159 | 149.7 | 53.6 | 219 | 206.2 | 73.8 | 279 | 262.7 | 94.0 |
| 40 | 37.7 | 13.5 | 100 | 94.2 | 33.7 | 160 | 150.7 | 53.9 | 220 | 207.1 | 74.1 | 280 | 263.6 | 94.3 |
| 41 | 38.6 | 13.8 | 101 | 95.1 | 34.0 | 161 | 151.6 | 54.2 | 221 | 208.1 | 74.5 | 281 | 264.6 | 94.7 |
| 42 | 39.5 | 14.2 | 102 | 96.0 | 34.4 | 162 | 152.5 | 54.6 | 222 | 209.0 | 74.8 | 282 | 265.5 | 95.0 |
| 43 | 40.5 | 14.5 | 103 | 97.0 | 34.7 | 163 | 153.5 | 54.9 | 223 | 210.0 | 75.1 | 283 | 266.5 | 95.3 |
| 44 | 41.4 | 14.8 | 104 | 97.9 | 35.0 | 164 | 154.4 | 55.3 | 224 | 210.9 | 75.5 | 284 | 267.4 | 95.7 |
| 45 | 42.4 | 15.2 | 105 | 98.9 | 35.4 | 165 | 155.4 | 55.6 | 225 | 211.9 | 75.8 | 285 | 268.3 | 96.0 |
| 46 | 43.3 | 15.5 | 106 | 99.8 | 35.7 | 166 | 156.3 | 55.9 | 226 | 212.8 | 76.1 | 286 | 269.3 | 96.4 |
| 47 | 44.3 | 15.8 | 107 | 100.7 | 36.1 | 167 | 157.2 | 56.3 | 227 | 213.7 | 76.5 | 287 | 270.2 | 96.7 |
| 48 | 45.2 | 16.2 | 108 | 101.7 | 36.4 | 168 | 158.2 | 56.6 | 228 | 214.7 | 76.8 | 288 | 271.2 | 97.0 |
| 49 | 46.1 | 16.5 | 109 | 102.6 | 36.7 | 169 | 159.1 | 56.9 | 229 | 215.6 | 77.2 | 289 | 272.1 | 97.4 |
| 50 | 47.1 | 16.8 | 110 | 103.6 | 37.1 | 170 | 160.1 | 57.3 | 230 | 216.6 | 77.5 | 290 | 273.0 | 97.7 |
| 51 | 48.0 | 17.2 | 111 | 104.5 | 37.4 | 171 | 161.0 | 57.6 | 231 | 217.5 | 77.8 | 291 | 274.0 | 98.0 |
| 52 | 49.0 | 17.5 | 112 | 105.5 | 37.7 | 172 | 161.9 | 58.0 | 232 | 218.4 | 78.2 | 292 | 274.9 | 98.4 |
| 53 | 49.9 | 17.9 | 113 | 106.4 | 38.1 | 173 | 162.9 | 58.3 | 233 | 219.4 | 78.5 | 293 | 275.9 | 98.7 |
| 54 | 50.8 | 18.2 | 114 | 107.3 | 38.4 | 174 | 163.8 | 58.6 | 234 | 220.3 | 78.8 | 294 | 276.8 | 99.0 |
| 55 | 51.8 | 18.5 | 115 | 108.3 | 38.7 | 175 | 164.8 | 59.0 | 235 | 221.3 | 79.2 | 295 | 277.8 | 99.4 |
| 56 | 52.7 | 18.9 | 116 | 109.2 | 39.1 | 176 | 165.7 | 59.3 | 236 | 222.2 | 79.5 | 296 | 278.7 | 99.7 |
| 57 | 53.7 | 19.2 | 117 | 110.2 | 39.4 | 177 | 166.7 | 59.6 | 237 | 223.1 | 79.8 | 297 | 279.6 | 100.1 |
| 58 | 54.6 | 19.5 | 118 | 111.1 | 39.8 | 178 | 167.6 | 60.0 | 238 | 224.1 | 80.2 | 298 | 280.6 | 100.4 |
| 59 | 55.6 | 19.9 | 119 | 112.0 | 40.1 | 179 | 168.5 | 60.3 | 239 | 225.0 | 80.5 | 299 | 281.5 | 100.7 |
| 60 | 56.5 | 20.2 | 120 | 113.0 | 40.4 | 180 | 169.5 | 60.6 | 240 | 226.0 | 80.9 | 300 | 282.5 | 101.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE I.

## Difference of Latitude and Departure for 2 Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 56.4 | 23.3 | 121 | 111.8 | 46.3 | 181 | 167.2 | 69.3 | 241 | 222.7 | 92.2 |
| 2 | 01.9 | 00.8 | 62 | 57.3 | 23.7 | 122 | 112.7 | 46.7 | 182 | 168.2 | 69.7 | 242 | 223.6 | 92.6 |
| 3 | 02.8 | 01.2 | 63 | 58.2 | 24.1 | 123 | 113.6 | 47.1 | 183 | 169.1 | 70.0 | 243 | 224.5 | 93.0 |
| 4 | 03.7 | 01.5 | 64 | 59.1 | 24.5 | 124 | 114.6 | 47.5 | 184 | 170.0 | 70.4 | 244 | 225.4 | 93.4 |
| 5 | 04.6 | 01.9 | 65 | 60.1 | 24.9 | 125 | 115.5 | 47.8 | 185 | 170.9 | 70.8 | 245 | 226.4 | 93.8 |
| 6 | 05.5 | 02.3 | 66 | 61.0 | 25.3 | 126 | 116.4 | 48.2 | 186 | 171.8 | 71.2 | 246 | 227.3 | 94.1 |
| 7 | 06.5 | 02.7 | 67 | 61.9 | 25.6 | 127 | 117.3 | 48.6 | 187 | 172.8 | 71.6 | 247 | 228.2 | 94.5 |
| 8 | 07.4 | 03.1 | 68 | 62.8 | 26.0 | 128 | 118.3 | 49.0 | 188 | 173.7 | 71.9 | 248 | 229.1 | 94.9 |
| 9 | 08.3 | 03.4 | 69 | 63.8 | 26.4 | 129 | 119.2 | 49.4 | 189 | 174.6 | 72.3 | 249 | 230.1 | 95.3 |
| 10 | 09.2 | 03.8 | 70 | 64.7 | 26.8 | 130 | 120.1 | 49.8 | 190 | 175.5 | 72.7 | 250 | 231.0 | 95.6 |
| 11 | 10.2 | 04.2 | 71 | 65.6 | 27.2 | 131 | 121.0 | 50.1 | 191 | 176.5 | 73.1 | 251 | 231.9 | 96.0 |
| 12 | 11.1 | 04.6 | 72 | 66.5 | 27.6 | 132 | 122.0 | 50.5 | 192 | 177.4 | 73.5 | 252 | 232.8 | 96.4 |
| 13 | 12.0 | 05.0 | 73 | 67.4 | 27.9 | 133 | 122.9 | 50.9 | 193 | 178.3 | 73.9 | 253 | 233.7 | 96.8 |
| 14 | 12.9 | 05.4 | 74 | 68.4 | 28.3 | 134 | 123.8 | 51.3 | 194 | 179.2 | 74.2 | 254 | 234.7 | 97.2 |
| 15 | 13.9 | 05.7 | 75 | 69.3 | 28.7 | 135 | 124.7 | 51.7 | 195 | 180.2 | 74.6 | 255 | 235.6 | 97.6 |
| 16 | 14.8 | 06.1 | 76 | 70.2 | 29.1 | 136 | 125.7 | 52.0 | 196 | 181.1 | 75.0 | 256 | 236.5 | 98.0 |
| 17 | 15.7 | 06.5 | 77 | 71.1 | 29.5 | 137 | 126.6 | 52.4 | 197 | 182.0 | 75.4 | 257 | 237.4 | 98.4 |
| 18 | 16.6 | 06.9 | 78 | 72.1 | 29.9 | 138 | 127.5 | 52.8 | 198 | 182.9 | 75.8 | 258 | 238.4 | 98.7 |
| 19 | 17.6 | 07.3 | 79 | 73.0 | 30.2 | 139 | 128.4 | 53.2 | 199 | 183.9 | 76.2 | 259 | 239.3 | 99.1 |
| 20 | 18.5 | 07.7 | 80 | 73.9 | 30.6 | 140 | 129.3 | 53.6 | 200 | 184.8 | 76.5 | 260 | 240.2 | 99.5 |
| 21 | 19.4 | 08.0 | 81 | 74.8 | 31.0 | 141 | 130.3 | 54.0 | 201 | 185.7 | 76.9 | 261 | 241.1 | 99.9 |
| 22 | 20.3 | 08.4 | 82 | 75.8 | 31.4 | 142 | 131.2 | 54.3 | 202 | 186.6 | 77.3 | 262 | 242.1 | 100.3 |
| 23 | 21.3 | 08.8 | 83 | 76.7 | 31.8 | 143 | 132.1 | 54.7 | 203 | 187.6 | 77.7 | 263 | 243.0 | 100.6 |
| 24 | 22.2 | 09.2 | 84 | 77.6 | 32.2 | 144 | 133.0 | 55.1 | 204 | 188.5 | 78.1 | 264 | 243.9 | 101.0 |
| 25 | 23.1 | 09.6 | 85 | 78.5 | 32.5 | 145 | 134.0 | 55.5 | 205 | 189.4 | 78.5 | 265 | 244.8 | 101.4 |
| 26 | 24.0 | 10.0 | 86 | 79.5 | 32.9 | 146 | 134.9 | 55.9 | 206 | 190.3 | 78.8 | 266 | 245.8 | 101.8 |
| 27 | 24.9 | 10.3 | 87 | 80.4 | 33.3 | 147 | 135.8 | 56.3 | 207 | 191.2 | 79.2 | 267 | 246.7 | 102.2 |
| 28 | 25.9 | 10.7 | 88 | 81.3 | 33.7 | 148 | 136.7 | 56.6 | 208 | 192.2 | 79.6 | 268 | 247.6 | 102.6 |
| 29 | 26.8 | 11.1 | 89 | 82.2 | 34.1 | 149 | 137.7 | 57.0 | 209 | 193.1 | 80.0 | 269 | 248.5 | 102.9 |
| 30 | 27.7 | 11.5 | 90 | 83.2 | 34.4 | 150 | 138.6 | 57.4 | 210 | 194.0 | 80.4 | 270 | 249.5 | 103.3 |
| 31 | 28.6 | 11.9 | 91 | 84.1 | 34.8 | 151 | 139.5 | 57.8 | 211 | 194.9 | 80.8 | 271 | 250.4 | 103.7 |
| 32 | 29.6 | 12.3 | 92 | 85.0 | 35.2 | 152 | 140.4 | 58.2 | 212 | 195.9 | 81.1 | 272 | 251.3 | 104.1 |
| 33 | 30.5 | 12.6 | 93 | 85.9 | 35.6 | 153 | 141.4 | 58.6 | 213 | 196.8 | 81.5 | 273 | 252.2 | 104.5 |
| 34 | 31.4 | 13.0 | 94 | 86.9 | 36.0 | 154 | 142.3 | 58.9 | 214 | 197.7 | 81.9 | 274 | 253.1 | 104.9 |
| 35 | 32.3 | 13.4 | 95 | 87.8 | 36.4 | 155 | 143.2 | 59.3 | 215 | 198.6 | 82.3 | 275 | 254.1 | 105.2 |
| 36 | 33.3 | 13.8 | 96 | 88.7 | 36.7 | 156 | 144.1 | 59.7 | 216 | 199.6 | 82.7 | 276 | 255.0 | 105.6 |
| 37 | 34.2 | 14.2 | 97 | 89.6 | 37.1 | 157 | 145.1 | 60.1 | 217 | 200.5 | 83.0 | 277 | 255.9 | 106.0 |
| 38 | 35.1 | 14.5 | 98 | 90.5 | 37.5 | 158 | 146.0 | 60.5 | 218 | 201.4 | 83.4 | 278 | 256.8 | 106.4 |
| 39 | 36.0 | 14.9 | 99 | 91.5 | 37.9 | 159 | 146.9 | 60.9 | 219 | 202.3 | 83.8 | 279 | 257.8 | 106.8 |
| 40 | 37.0 | 15.3 | 100 | 92.4 | 38.3 | 160 | 147.8 | 61.2 | 220 | 203.3 | 84.2 | 280 | 258.7 | 107.2 |
| 41 | 37.9 | 15.7 | 101 | 93.3 | 38.7 | 161 | 148.7 | 61.6 | 221 | 204.2 | 84.6 | 281 | 259.6 | 107.5 |
| 42 | 38.8 | 16.1 | 102 | 94.2 | 39.0 | 162 | 149.7 | 62.0 | 222 | 205.1 | 85.0 | 282 | 260.5 | 107.9 |
| 43 | 39.7 | 16.5 | 103 | 95.2 | 39.4 | 163 | 150.6 | 62.4 | 223 | 206.0 | 85.3 | 283 | 261.5 | 108.3 |
| 44 | 40.7 | 16.8 | 104 | 96.1 | 39.8 | 164 | 151.5 | 62.8 | 224 | 207.0 | 85.7 | 284 | 262.4 | 108.7 |
| 45 | 41.6 | 17.2 | 105 | 97.0 | 40.2 | 165 | 152.4 | 63.1 | 225 | 207.9 | 86.1 | 285 | 263.3 | 109.1 |
| 46 | 42.5 | 17.6 | 106 | 97.9 | 40.6 | 166 | 153.4 | 63.5 | 226 | 208.8 | 86.5 | 286 | 264.2 | 109.5 |
| 47 | 43.4 | 18.0 | 107 | 98.8 | 41.0 | 167 | 154.3 | 63.9 | 227 | 209.7 | 86.9 | 287 | 265.2 | 109.8 |
| 48 | 44.4 | 18.4 | 108 | 99.8 | 41.3 | 168 | 155.2 | 64.3 | 228 | 210.6 | 87.3 | 288 | 266.1 | 110.2 |
| 49 | 45.3 | 18.8 | 109 | 100.7 | 41.7 | 169 | 156.1 | 64.7 | 229 | 211.6 | 87.6 | 289 | 267.0 | 110.6 |
| 50 | 46.2 | 19.1 | 110 | 101.6 | 42.1 | 170 | 157.1 | 65.1 | 230 | 212.5 | 88.0 | 290 | 267.9 | 111.0 |
| 51 | 47.1 | 19.5 | 111 | 102.6 | 42.5 | 171 | 158.0 | 65.4 | 231 | 213.4 | 88.4 | 291 | 268.9 | 111.4 |
| 52 | 48.0 | 19.9 | 112 | 103.5 | 42.9 | 172 | 158.9 | 65.8 | 232 | 214.3 | 88.8 | 292 | 269.8 | 111.7 |
| 53 | 49.0 | 20.3 | 113 | 104.4 | 43.2 | 173 | 159.8 | 66.2 | 233 | 215.3 | 89.2 | 293 | 270.7 | 112.1 |
| 54 | 49.9 | 20.7 | 114 | 105.3 | 43.6 | 174 | 160.8 | 66.6 | 234 | 216.2 | 89.6 | 294 | 271.6 | 112.5 |
| 55 | 50.8 | 21.1 | 115 | 106.3 | 44.0 | 175 | 161.7 | 67.0 | 235 | 217.1 | 89.9 | 295 | 272.5 | 112.9 |
| 56 | 51.7 | 21.4 | 116 | 107.2 | 44.4 | 176 | 162.6 | 67.4 | 236 | 218.0 | 90.3 | 296 | 273.5 | 113.3 |
| 57 | 52.7 | 21.8 | 117 | 108.1 | 44.8 | 177 | 163.5 | 67.7 | 237 | 219.0 | 90.7 | 297 | 274.4 | 113.7 |
| 58 | 53.6 | 22.2 | 118 | 109.0 | 45.2 | 178 | 164.5 | 68.1 | 238 | 219.9 | 91.1 | 298 | 275.3 | 114.0 |
| 59 | 54.5 | 22.6 | 119 | 109.9 | 45.5 | 179 | 165.4 | 68.5 | 239 | 220.8 | 91.5 | 299 | 276.2 | 114.4 |
| 60 | 55.4 | 23.0 | 120 | 110.9 | 45.9 | 180 | 166.3 | 68.9 | 240 | 221.7 | 91.8 | 300 | 277.2 | 114.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 6 Points.

# TABLE I.

## Difference of Latitude and Departure for 2¼ Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 55.1 | 26.1 | 121 | 109.4 | 51.7 | 181 | 163.6 | 77.4 | 241 | 217.9 | 103.0 |
| 2 | 01.8 | 00.9 | 62 | 56.0 | 26.5 | 122 | 110.3 | 52.2 | 182 | 164.5 | 77.8 | 242 | 218.8 | 103.5 |
| 3 | 02.7 | 01.3 | 63 | 57.0 | 26.9 | 123 | 111.2 | 52.6 | 183 | 165.4 | 78.3 | 243 | 219.7 | 103.9 |
| 4 | 03.6 | 01.7 | 64 | 57.9 | 27.4 | 124 | 112.1 | 53.0 | 184 | 166.3 | 78.7 | 244 | 220.6 | 104.3 |
| 5 | 04.5 | 02.1 | 65 | 58.8 | 27.8 | 125 | 113.0 | 53.5 | 185 | 167.2 | 79.1 | 245 | 221.5 | 104.8 |
| 6 | 05.4 | 02.6 | 66 | 59.7 | 28.2 | 126 | 113.9 | 53.9 | 186 | 168.1 | 79.5 | 246 | 222.4 | 105.2 |
| 7 | 06.3 | 03.0 | 67 | 60.6 | 28.7 | 127 | 114.8 | 54.3 | 187 | 169.0 | 80.0 | 247 | 223.3 | 105.6 |
| 8 | 07.2 | 03.4 | 68 | 61.5 | 29.1 | 128 | 115.7 | 54.7 | 188 | 169.9 | 80.4 | 248 | 224.2 | 106.1 |
| 9 | 08.1 | 03.8 | 69 | 62.4 | 29.5 | 129 | 116.6 | 55.2 | 189 | 170.9 | 80.8 | 249 | 225.1 | 106.5 |
| 10 | 09.0 | 04.3 | 70 | 63.3 | 29.9 | 130 | 117.5 | 55.6 | 190 | 171.8 | 81.3 | 250 | 226.0 | 106.9 |
| 11 | 09.9 | 04.7 | 71 | 64.2 | 30.4 | 131 | 118.4 | 56.0 | 191 | 172.7 | 81.7 | 251 | 226.9 | 107.3 |
| 12 | 10.8 | 05.1 | 72 | 65.1 | 30.8 | 132 | 119.3 | 56.5 | 192 | 173.6 | 82.1 | 252 | 227.8 | 107.8 |
| 13 | 11.8 | 05.6 | 73 | 66.0 | 31.2 | 133 | 120.2 | 56.9 | 193 | 174.5 | 82.5 | 253 | 228.7 | 108.2 |
| 14 | 12.7 | 06.0 | 74 | 66.9 | 31.6 | 134 | 121.1 | 57.3 | 194 | 175.4 | 83.0 | 254 | 229.6 | 108.6 |
| 15 | 13.6 | 06.4 | 75 | 67.8 | 32.1 | 135 | 122.0 | 57.7 | 195 | 176.3 | 83.4 | 255 | 230.5 | 109.0 |
| 16 | 14.5 | 06.8 | 76 | 68.7 | 32.5 | 136 | 122.9 | 58.2 | 196 | 177.2 | 83.8 | 256 | 231.4 | 109.5 |
| 17 | 15.4 | 07.3 | 77 | 69.6 | 32.9 | 137 | 123.8 | 58.6 | 197 | 178.1 | 84.2 | 257 | 232.3 | 109.9 |
| 18 | 16.3 | 07.7 | 78 | 70.5 | 33.4 | 138 | 124.7 | 59.0 | 198 | 179.0 | 84.7 | 258 | 233.2 | 110.3 |
| 19 | 17.2 | 08.1 | 79 | 71.4 | 33.8 | 139 | 125.7 | 59.4 | 199 | 179.9 | 85.1 | 259 | 234.1 | 110.8 |
| 20 | 18.1 | 08.6 | 80 | 72.3 | 34.2 | 140 | 126.6 | 59.9 | 200 | 180.8 | 85.5 | 260 | 235.0 | 111.2 |
| 21 | 19.0 | 09.0 | 81 | 73.2 | 34.6 | 141 | 127.5 | 60.3 | 201 | 181.7 | 85.9 | 261 | 235.9 | 111.6 |
| 22 | 19.9 | 09.4 | 82 | 74.1 | 35.1 | 142 | 128.4 | 60.7 | 202 | 182.6 | 86.4 | 262 | 236.8 | 112.0 |
| 23 | 20.8 | 09.8 | 83 | 75.0 | 35.5 | 143 | 129.3 | 61.2 | 203 | 183.5 | 86.8 | 263 | 237.7 | 112.5 |
| 24 | 21.7 | 10.3 | 84 | 75.9 | 35.9 | 144 | 130.2 | 61.6 | 204 | 184.4 | 87.2 | 264 | 238.7 | 112.9 |
| 25 | 22.6 | 10.7 | 85 | 76.8 | 36.3 | 145 | 131.1 | 62.0 | 205 | 185.3 | 87.7 | 265 | 239.6 | 113.3 |
| 26 | 23.5 | 11.1 | 86 | 77.7 | 36.8 | 146 | 132.0 | 62.4 | 206 | 186.2 | 88.1 | 266 | 240.5 | 113.7 |
| 27 | 24.4 | 11.5 | 87 | 78.7 | 37.2 | 147 | 132.9 | 62.9 | 207 | 187.1 | 88.5 | 267 | 241.4 | 114.2 |
| 28 | 25.3 | 12.0 | 88 | 79.6 | 37.6 | 148 | 133.8 | 63.3 | 208 | 188.0 | 88.9 | 268 | 242.3 | 114.6 |
| 29 | 26.2 | 12.4 | 89 | 80.5 | 38.1 | 149 | 134.7 | 63.7 | 209 | 188.9 | 89.4 | 269 | 243.2 | 115.0 |
| 30 | 27.1 | 12.8 | 90 | 81.4 | 38.5 | 150 | 135.6 | 64.1 | 210 | 189.8 | 89.8 | 270 | 244.1 | 115.5 |
| 31 | 28.0 | 13.3 | 91 | 82.3 | 38.9 | 151 | 136.5 | 64.6 | 211 | 190.7 | 90.2 | 271 | 245.0 | 115.9 |
| 32 | 28.9 | 13.7 | 92 | 83.2 | 39.3 | 152 | 137.4 | 65.0 | 212 | 191.6 | 90.7 | 272 | 245.9 | 116.3 |
| 33 | 29.8 | 14.1 | 93 | 84.1 | 39.8 | 153 | 138.3 | 65.4 | 213 | 192.6 | 91.1 | 273 | 246.8 | 116.7 |
| 34 | 30.7 | 14.5 | 94 | 85.0 | 40.2 | 154 | 139.2 | 65.9 | 214 | 193.5 | 91.5 | 274 | 247.7 | 117.2 |
| 35 | 31.6 | 15.0 | 95 | 85.9 | 40.6 | 155 | 140·1 | 66.3 | 215 | 194.4 | 91.9 | 275 | 248.6 | 117.6 |
| 36 | 32.5 | 15.4 | 96 | 86.8 | 41.1 | 156 | 141.0 | 66.7 | 216 | 195.3 | 92.4 | 276 | 249.5 | 118.0 |
| 37 | 33.4 | 15.8 | 97 | 87.7 | 41.5 | 157 | 141.9 | 67.1 | 217 | 196.2 | 92.8 | 277 | 250.4 | 118.5 |
| 38 | 34.4 | 16.3 | 98 | 88.6 | 41.9 | 158 | 142.8 | 67.6 | 218 | 197.1 | 93.2 | 278 | 251.3 | 118.9 |
| 39 | 35.3 | 16.7 | 99 | 89.5 | 42.3 | 159 | 143.7 | 68.0 | 219 | 198.0 | 93.7 | 279 | 252.2 | 119.3 |
| 40 | 36.2 | 17.1 | 100 | 90.4 | 42.8 | 160 | 144.6 | 68.4 | 220 | 198.9 | 94.1 | 280 | 253.1 | 119.7 |
| 41 | 37.1 | 17.5 | 101 | 91.3 | 43.2 | 161 | 145.5 | 68.8 | 221 | 199.8 | 94.5 | 281 | 254.0 | 120.2 |
| 42 | 38.0 | 18.0 | 102 | 92.2 | 43.6 | 162 | 146.4 | 69.3 | 222 | 200.7 | 94.9 | 282 | 254.9 | 120.6 |
| 43 | 38.9 | 18.4 | 103 | 93.1 | 44.1 | 163 | 147.3 | 69.7 | 223 | 201.6 | 95.4 | 283 | 255.8 | 121.0 |
| 44 | 39.8 | 18.8 | 104 | 94.0 | 44.5 | 164 | 148.3 | 70.1 | 224 | 202.5 | 95.8 | 284 | 256.7 | 121.5 |
| 45 | 40.7 | 19.2 | 105 | 94.9 | 44.9 | 165 | 149.2 | 70.6 | 225 | 203.4 | 96.2 | 285 | 257.6 | 121.9 |
| 46 | 41.6 | 19.7 | 106 | 95.8 | 45.3 | 166 | 150.1 | 71.0 | 226 | 204.3 | 96.6 | 286 | 258.5 | 122.3 |
| 47 | 42.5 | 20.1 | 107 | 96.7 | 45.8 | 167 | 151.0 | 71.4 | 227 | 205.2 | 97.1 | 287 | 259.4 | 122.7 |
| 48 | 43.4 | 20.5 | 108 | 97.6 | 46.2 | 168 | 151.9 | 71.8 | 228 | 206.1 | 97.5 | 288 | 260.3 | 123.2 |
| 49 | 44.3 | 21.0 | 109 | 98.5 | 46.6 | 169 | 152.8 | 72.3 | 229 | 207.0 | 97.9 | 289 | 261.3 | 123.6 |
| 50 | 45.2 | 21.4 | 110 | 99.4 | 47.0 | 170 | 153.7 | 72.7 | 230 | 207.9 | 98.4 | 290 | 262.2 | 124.0 |
| 51 | 46.1 | 21.8 | 111 | 100.3 | 47.5 | 171 | 154.6 | 73.1 | 231 | 208.8 | 98.8 | 291 | 263.1 | 124.4 |
| 52 | 47.0 | 22.2 | 112 | 101.2 | 47.9 | 172 | 155.5 | 73.6 | 232 | 209.7 | 99.2 | 292 | 264.0 | 124.9 |
| 53 | 47.9 | 22.7 | 113 | 102.2 | 48.3 | 173 | 156.4 | 74.0 | 233 | 210.6 | 99.6 | 293 | 264.9 | 125.3 |
| 54 | 48.8 | 23.1 | 114 | 103.1 | 48.7 | 174 | 157.3 | 74.4 | 234 | 211.5 | 100.1 | 294 | 265.8 | 125.7 |
| 55 | 49.7 | 23.5 | 115 | 104.0 | 49.2 | 175 | 158.2 | 74.8 | 235 | 212.4 | 100.5 | 295 | 266.7 | 126.2 |
| 56 | 50.6 | 23.9 | 116 | 104.9 | 49.6 | 176 | 159.1 | 75.3 | 236 | 213.3 | 100.9 | 296 | 267.6 | 126.6 |
| 57 | 51.5 | 24.4 | 117 | 105.8 | 50.0 | 177 | 160.0 | 75.7 | 237 | 214.2 | 101.4 | 297 | 268.5 | 127.0 |
| 58 | 52.4 | 24.8 | 118 | 106.7 | 50.5 | 178 | 160.9 | 76.1 | 238 | 215.1 | 101.8 | 298 | 269.4 | 127.4 |
| 59 | 53.3 | 25.2 | 119 | 107.6 | 50.9 | 179 | 161.8 | 76.5 | 239 | 216.1 | 102.2 | 299 | 270.3 | 127.9 |
| 60 | 54.2 | 25.7 | 120 | 108.5 | 51.3 | 180 | 162.7 | 77.0 | 240 | 217.0 | 102.6 | 300 | 271.2 | 128.3 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

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# TABLE I.

## Difference of Latitude and Departure for 2 ½ Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.5 | 61 | 53.8 | 28.8 | 121 | 106.7 | 57.0 | 181 | 159.6 | 85.3 | 241 | 212.5 | 113.6 |
| 2 | 01.8 | 00.9 | 62 | 54.7 | 29.2 | 122 | 107.6 | 57.5 | 182 | 160.5 | 85.8 | 242 | 213.4 | 114.1 |
| 3 | 02.6 | 01.4 | 63 | 55.6 | 29.7 | 123 | 108.5 | 58.0 | 183 | 161.4 | 86.3 | 243 | 214.3 | 114.6 |
| 4 | 03.5 | 01.9 | 64 | 56.4 | 30.2 | 124 | 109.4 | 58.4 | 184 | 162.3 | 86.7 | 244 | 215.2 | 115.0 |
| 5 | 04.4 | 02.4 | 65 | 57.3 | 30.6 | 125 | 110.2 | 58.9 | 185 | 163.2 | 87.2 | 245 | 216.1 | 115.5 |
| 6 | 05.3 | 02.8 | 66 | 58.2 | 31.1 | 126 | 111.1 | 59.4 | 186 | 164.0 | 87.7 | 246 | 217.0 | 116.0 |
| 7 | 06.2 | 03.3 | 67 | 59.1 | 31.6 | 127 | 112.0 | 59.9 | 187 | 164.9 | 88.1 | 247 | 217.8 | 116.4 |
| 8 | 07.1 | 03.8 | 68 | 60.0 | 32.1 | 128 | 112.9 | 60.3 | 188 | 165.8 | 88.6 | 248 | 218.7 | 116.9 |
| 9 | 07.9 | 04.2 | 69 | 60.9 | 32.5 | 129 | 113.8 | 60.8 | 189 | 166.7 | 89.1 | 249 | 219.6 | 117.4 |
| 10 | 08.8 | 04.7 | 70 | 61.7 | 33.0 | 130 | 114.7 | 61.3 | 190 | 167.6 | 89.6 | 250 | 220.5 | 117.8 |
| 11 | 09.7 | 05.2 | 71 | 62.6 | 33.5 | 131 | 115.5 | 61.7 | 191 | 168.5 | 90.0 | 251 | 221.4 | 118.3 |
| 12 | 10.6 | 05.7 | 72 | 63.5 | 33.9 | 132 | 116.4 | 62.2 | 192 | 169.3 | 90.5 | 252 | 222.2 | 118.8 |
| 13 | 11.5 | 06.1 | 73 | 64.4 | 34.4 | 133 | 117.3 | 62.7 | 193 | 170.2 | 91.0 | 253 | 223.1 | 119.3 |
| 14 | 12.3 | 06.6 | 74 | 65.3 | 34.9 | 134 | 118.2 | 63.2 | 194 | 171.1 | 91.4 | 254 | 224.0 | 119.7 |
| 15 | 13.2 | 07.1 | 75 | 66.1 | 35.4 | 135 | 119.1 | 63.6 | 195 | 172.0 | 91.9 | 255 | 224.9 | 120.2 |
| 16 | 14.1 | 07.5 | 76 | 67.0 | 35.8 | 136 | 119.9 | 64.1 | 196 | 172.9 | 92.4 | 256 | 225.8 | 120.7 |
| 17 | 15.0 | 08.0 | 77 | 67.9 | 36.3 | 137 | 120.8 | 64.6 | 197 | 173.7 | 92.9 | 257 | 226.7 | 121.1 |
| 18 | 15.9 | 08.5 | 78 | 68.8 | 36.8 | 138 | 121.7 | 65.0 | 198 | 174.6 | 93.3 | 258 | 227.5 | 121.6 |
| 19 | 16.8 | 09.0 | 79 | 69.7 | 37.2 | 139 | 122.6 | 65.5 | 199 | 175.5 | 93.8 | 259 | 228.4 | 122.1 |
| 20 | 17.6 | 09.4 | 80 | 70.6 | 37.7 | 140 | 123.5 | 66.0 | 200 | 176.4 | 94.3 | 260 | 229.3 | 122.6 |
| 21 | 18.5 | 09.9 | 81 | 71.4 | 38.2 | 141 | 124.4 | 66.5 | 201 | 177.3 | 94.7 | 261 | 230.2 | 123.0 |
| 22 | 19.4 | 10.4 | 82 | 72.3 | 38.6 | 142 | 125.2 | 66.9 | 202 | 178.2 | 95.2 | 262 | 231.1 | 123.5 |
| 23 | 20.3 | 10.8 | 83 | 73.2 | 39.1 | 143 | 126.1 | 67.4 | 203 | 179.0 | 95.7 | 263 | 231.9 | 124.0 |
| 24 | 21.2 | 11.3 | 84 | 74.1 | 39.6 | 144 | 127.0 | 67.9 | 204 | 179.9 | 96.2 | 264 | 232.8 | 124.4 |
| 25 | 22.1 | 11.8 | 85 | 75.0 | 40.1 | 145 | 127.9 | 68.3 | 205 | 180.8 | 96.6 | 265 | 233.7 | 124.9 |
| 26 | 22.9 | 12.3 | 86 | 75.9 | 40.5 | 146 | 128.8 | 68.8 | 206 | 181.7 | 97.1 | 266 | 234.6 | 125.4 |
| 27 | 23.8 | 12.7 | 87 | 76.7 | 41.0 | 147 | 129.6 | 69.3 | 207 | 182.6 | 97.6 | 267 | 235.5 | 125.9 |
| 28 | 24.7 | 13.2 | 88 | 77.6 | 41.5 | 148 | 130.5 | 69.8 | 208 | 183.4 | 98.0 | 268 | 236.4 | 126.3 |
| 29 | 25.6 | 13.7 | 89 | 78.5 | 41.9 | 149 | 131.4 | 70.2 | 209 | 184.3 | 98.5 | 269 | 237.2 | 126.8 |
| 30 | 26.5 | 14.1 | 90 | 79.4 | 42.4 | 150 | 132.3 | 70.7 | 210 | 185.2 | 99.0 | 270 | 238.1 | 127.3 |
| 31 | 27.3 | 14.6 | 91 | 80.3 | 42.9 | 151 | 133.2 | 71.2 | 211 | 186.1 | 99.5 | 271 | 239.0 | 127.7 |
| 32 | 28.2 | 15.1 | 92 | 81.1 | 43.4 | 152 | 134.1 | 71.6 | 212 | 187.0 | 99.9 | 272 | 239.9 | 128.2 |
| 33 | 29.1 | 15.6 | 93 | 82.0 | 43.8 | 153 | 134.9 | 72.1 | 213 | 187.8 | 100.4 | 273 | 240.8 | 128.7 |
| 34 | 30.0 | 16.0 | 94 | 82.9 | 44.3 | 154 | 135.8 | 72.6 | 214 | 188.7 | 100.9 | 274 | 241.7 | 129.2 |
| 35 | 30.9 | 16.5 | 95 | 83 8 | 44.8 | 155 | 136.7 | 73.1 | 215 | 189.6 | 101.3 | 275 | 242.5 | 129.6 |
| 36 | 31.8 | 17.0 | 96 | 84.7 | 45.2 | 156 | 137.6 | 73.5 | 216 | 190.5 | 101.8 | 276 | 243.4 | 130.1 |
| 37 | 32.6 | 17.4 | 97 | 85.6 | 45.7 | 157 | 138.5 | 74.0 | 217 | 191.4 | 102.3 | 277 | 244.3 | 130.6 |
| 38 | 33.5 | 17.9 | 98 | 86.4 | 46.2 | 158 | 139.3 | 74.5 | 218 | 192.3 | 102.8 | 278 | 245.2 | 131.0 |
| 39 | 34.4 | 18.4 | 99 | 87.3 | 46.7 | 159 | 140.2 | 74.9 | 219 | 193.1 | 103.2 | 279 | 246.1 | 131.5 |
| 40 | 35.3 | 18.9 | 100 | 88.2 | 47.1 | 160 | 141.1 | 75.4 | 220 | 194.0 | 103.7 | 280 | 246.9 | 132.0 |
| 41 | 36.2 | 19.3 | 101 | 89.1 | 47.6 | 161 | 142.0 | 75.9 | 221 | 194.9 | 104.2 | 281 | 247.8 | 132.5 |
| 42 | 37.0 | 19.8 | 102 | 90.0 | 48.1 | 162 | 142.9 | 76.4 | 222 | 195.8 | 104.6 | 282 | 248.7 | 132.9 |
| 43 | 37.9 | 20.3 | 103 | 90.8 | 48.5 | 163 | 143.8 | 76.8 | 223 | 196.7 | 105.1 | 283 | 249.6 | 133.4 |
| 44 | 38.8 | 20.7 | 104 | 91.7 | 49.0 | 164 | 144.6 | 77.3 | 224 | 197.6 | 105.6 | 284 | 250.5 | 133.9 |
| 45 | 39.7 | 21.2 | 105 | 92.6 | 49.5 | 165 | 145.5 | 77.8 | 225 | 198.4 | 106.1 | 285 | 251.4 | 134.3 |
| 46 | 40.6 | 21.7 | 106 | 93.5 | 50.0 | 166 | 146.4 | 78.2 | 226 | 199.3 | 106.5 | 286 | 252.2 | 134.8 |
| 47 | 41.5 | 22.2 | 107 | 94.4 | 50.4 | 167 | 147.3 | 78.7 | 227 | 200.2 | 107.0 | 287 | 253.1 | 135.3 |
| 48 | 42.3 | 22.6 | 108 | 95.3 | 50.9 | 168 | 148.2 | 79.2 | 228 | 201.1 | 107.5 | 288 | 254.0 | 135.8 |
| 49 | 43.2 | 23.1 | 109 | 96.1 | 51.4 | 169 | 149.0 | 79.7 | 229 | 202.0 | 107.9 | 289 | 254.9 | 136.2 |
| 50 | 44.1 | 23.6 | 110 | 97.0 | 51.8 | 170 | 149.9 | 80.1 | 230 | 202.8 | 108.4 | 290 | 255.8 | 136.7 |
| 51 | 45.0 | 24.0 | 111 | 97.9 | 52.3 | 171 | 150.8 | 80.6 | 231 | 203.7 | 108.9 | 291 | 256.6 | 137.2 |
| 52 | 45.9 | 24.5 | 112 | 98.8 | 52.8 | 172 | 151.7 | 81.1 | 232 | 204.6 | 109.4 | 292 | 257.5 | 137.6 |
| 53 | 46.7 | 25.0 | 113 | 99.7 | 53.3 | 173 | 152.6 | 81.5 | 233 | 205.5 | 109.8 | 293 | 258.4 | 138.1 |
| 54 | 47.6 | 25.5 | 114 | 100.5 | 53.7 | 174 | 153.5 | 82.0 | 234 | 206.4 | 110.3 | 294 | 259.3 | 138.6 |
| 55 | 48.5 | 25.9 | 115 | 101.4 | 54.2 | 175 | 154.3 | 82.5 | 235 | 207.3 | 110.8 | 295 | 260.2 | 139.1 |
| 56 | 49.4 | 26.4 | 116 | 102.3 | 54.7 | 176 | 155.2 | 83.0 | 236 | 208.1 | 111.2 | 296 | 261.1 | 139.5 |
| 57 | 50.3 | 26.9 | 117 | 103.2 | 55.1 | 177 | 156.1 | 83.4 | 237 | 209.0 | 111.7 | 297 | 261.9 | 140.0 |
| 58 | 51.2 | 27.3 | 118 | 104.1 | 55.6 | 178 | 157.0 | 83.9 | 238 | 209.9 | 112.2 | 298 | 262.8 | 140.5 |
| 59 | 52.0 | 27.8 | 119 | 105.0 | 56.1 | 179 | 157.9 | 84.4 | 239 | 210.8 | 112.7 | 299 | 263.7 | 140.9 |
| 60 | 52.9 | 28.3 | 120 | 105.8 | 56.6 | 180 | 158.8 | 84.8 | 240 | 211.7 | 113.1 | 300 | 264.6 | 141.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 5 ½ Points.

# TABLE I.

## Difference of Latitude and Departure for 2¾ Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.5 | 61 | 52.3 | 31.4 | 121 | 103.8 | 62.2 | 181 | 155.3 | 93.0 | 241 | 206.7 | 123.9 |
| 2 | 01.7 | 01.0 | 62 | 53.2 | 31.9 | 122 | 104.6 | 62.7 | 182 | 156.1 | 93.6 | 242 | 207.6 | 124.4 |
| 3 | 02.6 | 01.5 | 63 | 54.0 | 32.4 | 123 | 105.5 | 63.2 | 183 | 157.0 | 94.1 | 243 | 208.4 | 124.9 |
| 4 | 03.4 | 02.1 | 64 | 54.9 | 32.9 | 124 | 106.4 | 63.7 | 184 | 157.8 | 94.6 | 244 | 209.3 | 125.4 |
| 5 | 04.3 | 02.6 | 65 | 55.8 | 33.4 | 125 | 107.2 | 64.3 | 185 | 158.7 | 95.1 | 245 | 210.1 | 125.9 |
| 6 | 05.1 | 03.1 | 66 | 56.6 | 33.9 | 126 | 108.1 | 64.8 | 186 | 159.5 | 95.6 | 246 | 211.0 | 126.5 |
| 7 | 06.0 | 03.6 | 67 | 57.5 | 34.4 | 127 | 108.9 | 65.3 | 187 | 160.4 | 96.1 | 247 | 211.9 | 127.0 |
| 8 | 06.9 | 04.1 | 68 | 58.3 | 35.0 | 128 | 109.8 | 65.8 | 188 | 161.2 | 96.6 | 248 | 212.7 | 127.5 |
| 9 | 07.7 | 04.6 | 69 | 59.2 | 35.5 | 129 | 110.6 | 66.3 | 189 | 162.1 | 97.2 | 249 | 213.6 | 128.0 |
| 10 | 08.6 | 05.1 | 70 | 60.0 | 36.0 | 130 | 111.5 | 66.8 | 190 | 163.0 | 97.7 | 250 | 214.4 | 128.5 |
| 11 | 09.4 | 05.7 | 71 | 60.9 | 36.5 | 131 | 112.4 | 67.3 | 191 | 163.8 | 98.2 | 251 | 215.3 | 129.0 |
| 12 | 10.3 | 06.2 | 72 | 61.8 | 37.0 | 132 | 113.2 | 67.9 | 192 | 164.7 | 98.7 | 252 | 216.1 | 129.5 |
| 13 | 11.2 | 06.7 | 73 | 62.6 | 37.5 | 133 | 114.1 | 68.4 | 193 | 165.5 | 99.2 | 253 | 217.0 | 130.1 |
| 14 | 12.0 | 07.2 | 74 | 63.5 | 38.0 | 134 | 114.9 | 68.9 | 194 | 166.4 | 99.7 | 254 | 217.9 | 130.6 |
| 15 | 12.9 | 07.7 | 75 | 64.3 | 38.6 | 135 | 115.8 | 69.4 | 195 | 167.3 | 100.2 | 255 | 218.7 | 131.1 |
| 16 | 13.7 | 08.2 | 76 | 65.2 | 39.1 | 136 | 116.6 | 69.9 | 196 | 168.1 | 100.8 | 256 | 219.6 | 131.6 |
| 17 | 14.6 | 08.7 | 77 | 66.0 | 39.6 | 137 | 117.5 | 70.4 | 197 | 169.0 | 101.3 | 257 | 220.4 | 132.1 |
| 18 | 15.4 | 09.3 | 78 | 66.9 | 40.1 | 138 | 118.4 | 70.9 | 198 | 169.8 | 101.8 | 258 | 221.3 | 132.6 |
| 19 | 16.3 | 09.8 | 79 | 67.8 | 40.6 | 139 | 119.2 | 71.5 | 199 | 170.7 | 102.3 | 259 | 222.2 | 133.1 |
| 20 | 17.2 | 10.3 | 80 | 68.6 | 41.1 | 140 | 120.1 | 72.0 | 200 | 171.5 | 102.8 | 260 | 223.0 | 133.7 |
| 21 | 18.0 | 10.8 | 81 | 69.5 | 41.6 | 141 | 120.9 | 72.5 | 201 | 172.4 | 103.3 | 261 | 223.9 | 134.2 |
| 22 | 18.9 | 11.3 | 82 | 70.3 | 42.1 | 142 | 121.8 | 73.0 | 202 | 173.3 | 103.8 | 262 | 224.7 | 134.7 |
| 23 | 19.7 | 11.8 | 83 | 71.2 | 42.7 | 143 | 122.7 | 73.5 | 203 | 174.1 | 104.4 | 263 | 225.6 | 135.2 |
| 24 | 20.6 | 12.3 | 84 | 72.0 | 43.2 | 144 | 123.5 | 74.0 | 204 | 175.0 | 104.9 | 264 | 226.4 | 135.7 |
| 25 | 21.4 | 12.9 | 85 | 72.9 | 43.7 | 145 | 124.4 | 74.5 | 205 | 175.8 | 105.4 | 265 | 227.3 | 136.2 |
| 26 | 22.3 | 13.4 | 86 | 73.8 | 44.2 | 146 | 125.2 | 75.1 | 206 | 176.7 | 105.9 | 266 | 228.2 | 136.7 |
| 27 | 23.2 | 13.9 | 87 | 74.6 | 44.7 | 147 | 126.1 | 75.6 | 207 | 177.5 | 106.4 | 267 | 229.0 | 137.3 |
| 28 | 24.0 | 14.4 | 88 | 75.5 | 45.2 | 148 | 126.9 | 76.1 | 208 | 178.4 | 106.9 | 268 | 229.9 | 137.8 |
| 29 | 24.9 | 14.9 | 89 | 76.3 | 45.7 | 149 | 127.8 | 76.6 | 209 | 179.3 | 107.4 | 269 | 230.7 | 138.3 |
| 30 | 25.7 | 15.4 | 90 | 77.2 | 46.3 | 150 | 128.7 | 77.1 | 210 | 180.1 | 108.0 | 270 | 231.6 | 138.8 |
| 31 | 26.6 | 15.9 | 91 | 78.1 | 46.8 | 151 | 129.5 | 77.6 | 211 | 181.0 | 108.5 | 271 | 232.4 | 139.3 |
| 32 | 27.4 | 16.5 | 92 | 78.9 | 47.3 | 152 | 130.4 | 78.1 | 212 | 181.8 | 109.0 | 272 | 233.3 | 139.8 |
| 33 | 28.3 | 17.0 | 93 | 79.8 | 47.8 | 153 | 131.2 | 78.7 | 213 | 182.7 | 109.5 | 273 | 234.2 | 140.3 |
| 34 | 29.2 | 17.5 | 94 | 80.6 | 48.3 | 154 | 132.1 | 79.2 | 214 | 183.5 | 110.0 | 274 | 235.0 | 140.9 |
| 35 | 30.0 | 18.0 | 95 | 81.5 | 48.8 | 155 | 132.9 | 79.7 | 215 | 184.4 | 110.5 | 275 | 235.9 | 141.4 |
| 36 | 30.9 | 18.5 | 96 | 82.3 | 49.3 | 156 | 133.8 | 80.2 | 216 | 185.3 | 111.0 | 276 | 236.7 | 141.9 |
| 37 | 31.7 | 19.0 | 97 | 83.2 | 49.9 | 157 | 134.7 | 80.7 | 217 | 186.1 | 111.6 | 277 | 237.6 | 142.4 |
| 38 | 32.6 | 19.5 | 98 | 84.1 | 50.4 | 158 | 135.5 | 81.2 | 218 | 187.0 | 112.1 | 278 | 238.4 | 142.9 |
| 39 | 33.5 | 20.1 | 99 | 84.9 | 50.9 | 159 | 136.4 | 81.7 | 219 | 187.8 | 112.6 | 279 | 239.3 | 143.4 |
| 40 | 34.3 | 20.6 | 100 | 85.8 | 51.4 | 160 | 137.2 | 82.3 | 220 | 188.7 | 113.1 | 280 | 240.2 | 143.9 |
| 41 | 35.2 | 21.1 | 101 | 86.6 | 51.9 | 161 | 138.1 | 82.8 | 221 | 189.6 | 113.6 | 281 | 241.0 | 144.5 |
| 42 | 36.0 | 21.6 | 102 | 87.5 | 52.4 | 162 | 138.9 | 83.3 | 222 | 190.4 | 114.1 | 282 | 241.9 | 145.0 |
| 43 | 36.9 | 22.1 | 103 | 88.3 | 52.9 | 163 | 139.8 | 83.8 | 223 | 191.3 | 114.6 | 283 | 242.7 | 145.5 |
| 44 | 37.7 | 22.6 | 104 | 89.2 | 53.5 | 164 | 140·7 | 84.3 | 224 | 192.1 | 115.2 | 284 | 243.6 | 146.0 |
| 45 | 38.6 | 23.1 | 105 | 90.1 | 54.0 | 165 | 141.5 | 84.8 | 225 | 193.0 | 115.7 | 285 | 244.4 | 146.5 |
| 46 | 39.5 | 23.6 | 106 | 90.9 | 54.5 | 166 | 142.4 | 85.3 | 226 | 193.8 | 116.2 | 286 | 245.3 | 147.0 |
| 47 | 40.3 | 24.2 | 107 | 91.8 | 55.0 | 167 | 143.2 | 85.8 | 227 | 194.7 | 116.7 | 287 | 246.2 | 147.5 |
| 48 | 41.2 | 24.7 | 108 | 92.6 | 55.5 | 168 | 144.1 | 86.4 | 228 | 195.6 | 117.2 | 288 | 247.0 | 148.1 |
| 49 | 42.0 | 25.2 | 109 | 93.5 | 56.0 | 169 | 145.0 | 86.9 | 229 | 196.4 | 117.7 | 289 | 247.9 | 148.6 |
| 50 | 42.9 | 25.7 | 110 | 94.3 | 56.5 | 170 | 145.8 | 87.4 | 230 | 197.3 | 118.2 | 290 | 248.7 | 149.1 |
| 51 | 43.7 | 26.2 | 111 | 95.2 | 57.1 | 171 | 146.7 | 87.9 | 231 | 198.1 | 118.8 | 291 | 249.6 | 149.6 |
| 52 | 44.6 | 26.7 | 112 | 96.1 | 57.6 | 172 | 147.5 | 88.4 | 232 | 199.0 | 119.3 | 292 | 250.5 | 150.1 |
| 53 | 45.5 | 27.2 | 113 | 96.9 | 58.1 | 173 | 148.4 | 88.9 | 233 | 199.8 | 119.8 | 293 | 251.3 | 150.6 |
| 54 | 46.3 | 27.8 | 114 | 97.8 | 58.6 | 174 | 149.2 | 89.4 | 234 | 200.7 | 120.3 | 294 | 252.2 | 151.1 |
| 55 | 47.2 | 28.3 | 115 | 98.6 | 59.1 | 175 | 150.1 | 90.0 | 235 | 201.6 | 120.8 | 295 | 253.0 | 151.7 |
| 56 | 48.0 | 28.8 | 116 | 99.5 | 59.6 | 176 | 151.0 | 90.5 | 236 | 202.4 | 121.3 | 296 | 253.9 | 152.2 |
| 57 | 48.9 | 29.3 | 117 | 100.4 | 60.1 | 177 | 151.8 | 91.0 | 237 | 203.3 | 121.8 | 297 | 254.7 | 152.7 |
| 58 | 49.7 | 29.8 | 118 | 101.2 | 60.7 | 178 | 152.7 | 91.5 | 238 | 204.1 | 122.4 | 298 | 255.6 | 153.2 |
| 59 | 50.6 | 30.3 | 119 | 102.1 | 61.2 | 179 | 153.5 | 92.0 | 239 | 205.0 | 122.9 | 299 | 256.5 | 153.7 |
| 60 | 51.5 | 30.8 | 120 | 102.9 | 61.7 | 180 | 154.4 | 92.5 | 240 | 205.9 | 123.4 | 300 | 257.3 | 154.2 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 5½ Points.

# TABLE I.

## Difference of Latitude and Departure for 3 Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 50.7 | 33.9 | 121 | 100.6 | 67.2 | 181 | 150.5 | 100.6 | 241 | 200.4 | 133.9 |
| 2 | 01.7 | 01.1 | 62 | 51.5 | 34.4 | 122 | 101.4 | 67.8 | 182 | 151.3 | 101.1 | 242 | 201.2 | 134.4 |
| 3 | 02.5 | 01.7 | 63 | 52.4 | 35.0 | 123 | 102.3 | 68.3 | 183 | 152.2 | 101.7 | 243 | 202.0 | 135.0 |
| 4 | 03.3 | 02.2 | 64 | 53.2 | 35.6 | 124 | 103.1 | 68.9 | 184 | 153.0 | 102.2 | 244 | 202.9 | 135.6 |
| 5 | 04.2 | 02.8 | 65 | 54.0 | 36.1 | 125 | 103.9 | 69.4 | 185 | 153.8 | 102.8 | 245 | 203.7 | 136.1 |
| 6 | 05.0 | 03.3 | 66 | 54.9 | 36.7 | 126 | 104.8 | 70.0 | 186 | 154.6 | 103.3 | 246 | 204.5 | 136.7 |
| 7 | 05.8 | 03.9 | 67 | 55.7 | 37.2 | 127 | 105.6 | 70.6 | 187 | 155.5 | 103.9 | 247 | 205.4 | 137.2 |
| 8 | 06.7 | 04.4 | 68 | 56.5 | 37.8 | 128 | 106.4 | 71.1 | 188 | 156.3 | 104.4 | 248 | 206.2 | 137.8 |
| 9 | 07.5 | 05.0 | 69 | 57.4 | 38.3 | 129 | 107.3 | 71.7 | 189 | 157.1 | 105.0 | 249 | 207.0 | 138.3 |
| 10 | 08.3 | 05.6 | 70 | 58.2 | 38.9 | 130 | 108.1 | 72.2 | 190 | 158.0 | 105.6 | 250 | 207.9 | 138.9 |
| 11 | 09.1 | 06.1 | 71 | 59.0 | 39.4 | 131 | 108.9 | 72.8 | 191 | 158.8 | 106.1 | 251 | 208.7 | 139.4 |
| 12 | 10.0 | 06.7 | 72 | 59.9 | 40.0 | 132 | 109.7 | 73.3 | 192 | 159.6 | 106.7 | 252 | 209.5 | 140.0 |
| 13 | 10.8 | 07.2 | 73 | 60.7 | 40.6 | 133 | 110.6 | 73.9 | 193 | 160.5 | 107.2 | 253 | 210.4 | 140.6 |
| 14 | 11.6 | 07.8 | 74 | 61.5 | 41.1 | 134 | 111.4 | 74.4 | 194 | 161.3 | 107.8 | 254 | 211.2 | 141.1 |
| 15 | 12.5 | 08.3 | 75 | 62.4 | 41.7 | 135 | 112.2 | 75.0 | 195 | 162.1 | 108.3 | 255 | 212.0 | 141.7 |
| 16 | 13.3 | 08.9 | 76 | 63.2 | 42.2 | 136 | 113.1 | 75.6 | 196 | 163.0 | 106.9 | 256 | 212.9 | 142.2 |
| 17 | 14.1 | 09.4 | 77 | 64.0 | 42.8 | 137 | 113.9 | 76.1 | 197 | 163.8 | 109.4 | 257 | 213.7 | 142.8 |
| 18 | 15.0 | 10.0 | 78 | 64.8 | 43.3 | 138 | 114.7 | 76.7 | 198 | 164.6 | 110.0 | 258 | 214.5 | 143.3 |
| 19 | 15.8 | 10.6 | 79 | 65.7 | 43.9 | 139 | 115.6 | 77.2 | 199 | 165.5 | 110.6 | 259 | 215.3 | 143.9 |
| 20 | 16.6 | 11.1 | 80 | 66.5 | 44.4 | 140 | 116.4 | 77.8 | 200 | 166.3 | 111.1 | 260 | 216.2 | 144.4 |
| 21 | 17.5 | 11.7 | 81 | 67.3 | 45.0 | 141 | 117.2 | 78.3 | 201 | 167.1 | 111.7 | 261 | 217.0 | 145.0 |
| 22 | 18.3 | 12.2 | 82 | 68.2 | 45.6 | 142 | 118.1 | 78.9 | 202 | 168.0 | 112.2 | 262 | 217.8 | 145.6 |
| 23 | 19.1 | 12.8 | 83 | 69.0 | 46.1 | 143 | 118.9 | 79.4 | 203 | 168.8 | 112.8 | 263 | 218.7 | 146.1 |
| 24 | 20.0 | 13.3 | 84 | 69.8 | 46.7 | 144 | 119.7 | 80.0 | 204 | 169.6 | 113.3 | 264 | 219.5 | 146.7 |
| 25 | 20.8 | 13.9 | 85 | 70.7 | 47.2 | 145 | 120.6 | 80.6 | 205 | 170.4 | 113.9 | 265 | 220.3 | 147.2 |
| 26 | 21.6 | 14.4 | 86 | 71.5 | 47.8 | 146 | 121.4 | 81.1 | 206 | 171.3 | 114.4 | 266 | 221.2 | 147.8 |
| 27 | 22.4 | 15.0 | 87 | 72.3 | 48.3 | 147 | 122.2 | 81.7 | 207 | 172.1 | 115.0 | 267 | 222.0 | 148.3 |
| 28 | 23.3 | 15.6 | 88 | 73.2 | 48.9 | 148 | 123.1 | 82.2 | 208 | 172.9 | 115.6 | 268 | 222.8 | 148.9 |
| 29 | 24.1 | 16.1 | 89 | 74.0 | 49.4 | 149 | 123.9 | 82.8 | 209 | 173.8 | 116.1 | 269 | 223.7 | 149.4 |
| 30 | 24.9 | 16.7 | 90 | 74.8 | 50.0 | 150 | 124.7 | 83.3 | 210 | 174.6 | 116.7 | 270 | 224.5 | 150.0 |
| 31 | 25.8 | 17.2 | 91 | 75.7 | 50.6 | 151 | 125.5 | 83.9 | 211 | 175.4 | 117.2 | 271 | 225.3 | 150.6 |
| 32 | 26.6 | 17.8 | 92 | 76.5 | 51.1 | 152 | 126.4 | 84.4 | 212 | 176.3 | 117.8 | 272 | 226.2 | 151.1 |
| 33 | 27.4 | 18.3 | 93 | 77.3 | 51.7 | 153 | 127.2 | 85.0 | 213 | 177.1 | 118.3 | 273 | 227.0 | 151.7 |
| 34 | 28.3 | 18.9 | 94 | 78.2 | 52.2 | 154 | 128.0 | 85.6 | 214 | 177.9 | 118.9 | 274 | 227.8 | 152.2 |
| 35 | 29.1 | 19.4 | 95 | 79.0 | 52.8 | 155 | 128.9 | 86.1 | 215 | 178.8 | 119.4 | 275 | 228.6 | 152.8 |
| 36 | 29.9 | 20.0 | 96 | 79.8 | 53.3 | 156 | 129.7 | 86.7 | 216 | 179.6 | 120.0 | 276 | 229.5 | 153.3 |
| 37 | 30.8 | 20.6 | 97 | 80.6 | 53.9 | 157 | 130.5 | 87.2 | 217 | 180.4 | 120.6 | 277 | 230.3 | 153.9 |
| 38 | 31.6 | 21.1 | 98 | 81.5 | 54.4 | 158 | 131.4 | 87.8 | 218 | 181.3 | 121.1 | 278 | 231.1 | 154.4 |
| 39 | 32.4 | 21.7 | 99 | 82.3 | 55.0 | 159 | 132.2 | 88.3 | 219 | 182.1 | 121.7 | 279 | 232.0 | 155.0 |
| 40 | 33.3 | 22.2 | 100 | 83.1 | 55.6 | 160 | 133.0 | 88.9 | 220 | 182.9 | 122.2 | 280 | 232.8 | 155.6 |
| 41 | 34.1 | 22.8 | 101 | 84.0 | 56.1 | 161 | 133.9 | 89.4 | 221 | 183.7 | 122.8 | 281 | 233.6 | 156.1 |
| 42 | 34.9 | 23.3 | 102 | 84.8 | 56.7 | 162 | 134.7 | 90.0 | 222 | 184.6 | 123.3 | 282 | 234.5 | 156.7 |
| 43 | 35.8 | 23.9 | 103 | 85.6 | 57.2 | 163 | 135.5 | 90.6 | 223 | 185.4 | 123.9 | 283 | 235.3 | 157.2 |
| 44 | 36.6 | 24.4 | 104 | 86.5 | 57.8 | 164 | 136.4 | 91.1 | 224 | 186.2 | 124.4 | 284 | 236.1 | 157.8 |
| 45 | 37.4 | 25.0 | 105 | 87.3 | 58.3 | 165 | 137.2 | 91.7 | 225 | 187.1 | 125.0 | 285 | 237.0 | 158.3 |
| 46 | 38.2 | 25.6 | 106 | 88.1 | 58.9 | 166 | 138.0 | 92.2 | 226 | 187.9 | 125.6 | 286 | 237.8 | 158.9 |
| 47 | 39.1 | 26.1 | 107 | 89.0 | 59.4 | 167 | 138.9 | 92.8 | 227 | 188.7 | 126.1 | 287 | 238.6 | 159.4 |
| 48 | 39.9 | 26.7 | 108 | 89.8 | 60.0 | 168 | 139.7 | 93.3 | 228 | 189.6 | 126.7 | 288 | 239.5 | 160.0 |
| 49 | 40.7 | 27.2 | 109 | 90.6 | 60.6 | 169 | 140.5 | 93.9 | 229 | 190.4 | 127.2 | 289 | 240.3 | 160.6 |
| 50 | 41.6 | 27.8 | 110 | 91.5 | 61.1 | 170 | 141.3 | 94.4 | 230 | 191.2 | 127.8 | 290 | 241.1 | 161.1 |
| 51 | 42.4 | 28.3 | 111 | 92.3 | 61.7 | 171 | 142.2 | 95.0 | 231 | 192.1 | 128.3 | 291 | 242.0 | 161.7 |
| 52 | 43.2 | 28.9 | 112 | 93.1 | 62.2 | 172 | 143.0 | 95.6 | 232 | 192.9 | 128.9 | 292 | 242.8 | 162.2 |
| 53 | 44.1 | 29.4 | 113 | 94.0 | 62.8 | 173 | 143.8 | 96.1 | 233 | 193.7 | 129.4 | 293 | 243.6 | 162.8 |
| 54 | 44.9 | 30.0 | 114 | 94.8 | 63.3 | 174 | 144.7 | 96.7 | 234 | 194.6 | 130.0 | 294 | 244.4 | 163.3 |
| 55 | 45.7 | 30.6 | 115 | 95.6 | 63.9 | 175 | 145.5 | 97.2 | 235 | 195.4 | 130.6 | 295 | 245.3 | 163.9 |
| 56 | 46.6 | 31.1 | 116 | 96.4 | 64.4 | 176 | 146.3 | 97.8 | 236 | 196.2 | 131.1 | 296 | 246.1 | 164.4 |
| 57 | 47.4 | 31.7 | 117 | 97.3 | 65.0 | 177 | 147.2 | 98.3 | 237 | 197.1 | 131.7 | 297 | 246.9 | 165.0 |
| 58 | 48.2 | 32.2 | 118 | 98.1 | 65.6 | 178 | 148.0 | 98.9 | 238 | 197.9 | 132.2 | 298 | 247.8 | 165.6 |
| 59 | 49.1 | 32.8 | 119 | 98.9 | 66.1 | 179 | 148.8 | 99.4 | 239 | 198.7 | 132.8 | 299 | 248.6 | 166.1 |
| 60 | 49.9 | 33.3 | 120 | 99.8 | 66.7 | 180 | 149.7 | 100.0 | 240 | 199.5 | 133.3 | 300 | 249.4 | 166.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 5 Points.

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# TABLE I.

## Difference of Latitude and Departure for 3¼ Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 49.0 | 36.3 | 121 | 97.2 | 72.1 | 181 | 145.4 | 107.8 | 241 | 193.6 | 143.6 |
| 2 | 01.6 | 01.2 | 62 | 49.8 | 36.9 | 122 | 98.0 | 72.7 | 182 | 146.2 | 108.4 | 242 | 194.4 | 144.2 |
| 3 | 02.4 | 01.8 | 63 | 50.6 | 37.5 | 123 | 98.8 | 73.3 | 183 | 147.0 | 109.0 | 243 | 195.2 | 144.8 |
| 4 | 03.2 | 02.4 | 64 | 51.4 | 38.1 | 124 | 99.6 | 73.9 | 184 | 147.8 | 109.6 | 244 | 196.0 | 145.4 |
| 5 | 04.0 | 03.0 | 65 | 52.2 | 38.7 | 125 | 100.4 | 74.5 | 185 | 148.6 | 110.2 | 245 | 196.8 | 146.0 |
| 6 | 04.8 | 03.6 | 66 | 53.0 | 39.3 | 126 | 101.2 | 75.1 | 186 | 149.4 | 110.8 | 246 | 197.6 | 146.5 |
| 7 | 05.6 | 04.2 | 67 | 53.8 | 39.9 | 127 | 102.0 | 75.7 | 187 | 150.2 | 111.4 | 247 | 198.4 | 147.1 |
| 8 | 06.4 | 04.8 | 68 | 54.6 | 40.5 | 128 | 102.8 | 76.3 | 188 | 151.0 | 112.0 | 248 | 199.2 | 147.7 |
| 9 | 07.2 | 05.4 | 69 | 55.4 | 41.1 | 129 | 103.6 | 76.9 | 189 | 151.8 | 112.6 | 249 | 200.0 | 148.3 |
| 10 | 08.0 | 06.0 | 70 | 56.2 | 41.7 | 130 | 104.4 | 77.4 | 190 | 152.6 | 113.2 | 250 | 200.8 | 148.9 |
| 11 | 08.8 | 06.6 | 71 | 57.0 | 42.3 | 131 | 105.2 | 78.0 | 191 | 153.4 | 113.8 | 251 | 201.6 | 149.5 |
| 12 | 09.6 | 07.1 | 72 | 57.8 | 42.9 | 132 | 106.0 | 78.6 | 192 | 154.2 | 114.4 | 252 | 202.4 | 150.1 |
| 13 | 10.4 | 07.7 | 73 | 58.6 | 43.5 | 133 | 106.8 | 79.2 | 193 | 155.0 | 115.0 | 253 | 203.2 | 150.7 |
| 14 | 11.2 | 08.3 | 74 | 59.4 | 44.1 | 134 | 107.6 | 79.8 | 194 | 155.8 | 115.6 | 254 | 204.0 | 151.3 |
| 15 | 12.0 | 08.9 | 75 | 60.2 | 44.7 | 135 | 108.4 | 80.4 | 195 | 156.6 | 116.2 | 255 | 204.8 | 151.9 |
| 16 | 12.9 | 09.5 | 76 | 61.0 | 45.3 | 136 | 109.2 | 81.0 | 196 | 157.4 | 116.8 | 256 | 205.6 | 152.5 |
| 17 | 13.7 | 10.1 | 77 | 61.8 | 45.9 | 137 | 110.0 | 81.6 | 197 | 158.2 | 117.4 | 257 | 206.4 | 153.1 |
| 18 | 14.5 | 10.7 | 78 | 62.6 | 46.5 | 138 | 110.8 | 82.2 | 198 | 159.0 | 118.0 | 258 | 207.2 | 153.7 |
| 19 | 15.3 | 11.3 | 79 | 63.4 | 47.1 | 139 | 111.6 | 82.8 | 199 | 159.8 | 118.5 | 259 | 208.0 | 154.3 |
| 20 | 16.1 | 11.9 | 80 | 64.3 | 47.7 | 140 | 112.4 | 83.4 | 200 | 160.6 | 119.1 | 260 | 208.8 | 154.9 |
| 21 | 16.9 | 12.5 | 81 | 65.1 | 48.3 | 141 | 113.2 | 84.0 | 201 | 161.4 | 119.7 | 261 | 209.6 | 155.5 |
| 22 | 17.7 | 13.1 | 82 | 65.9 | 48.9 | 142 | 114.0 | 84.6 | 202 | 162.2 | 120.3 | 262 | 210.4 | 156.1 |
| 23 | 18.5 | 13.7 | 83 | 66.7 | 49.4 | 143 | 114.9 | 85.2 | 203 | 163.0 | 120.9 | 263 | 211.2 | 156.7 |
| 24 | 19.3 | 14.3 | 84 | 67.5 | 50.0 | 144 | 115.7 | 85.8 | 204 | 163.9 | 121.5 | 264 | 212.0 | 157.3 |
| 25 | 20.1 | 14.9 | 85 | 68.3 | 50.6 | 145 | 116.5 | 86.4 | 205 | 164.7 | 122.1 | 265 | 212.8 | 157.9 |
| 26 | 20.9 | 15.5 | 86 | 69.1 | 51.2 | 146 | 117.3 | 87.0 | 206 | 165.5 | 122.7 | 266 | 213.6 | 158.5 |
| 27 | 21.7 | 16.1 | 87 | 69.9 | 51.8 | 147 | 118.1 | 87.6 | 207 | 166.3 | 123.3 | 267 | 214.5 | 159.1 |
| 28 | 22.5 | 16.7 | 88 | 70.7 | 52.4 | 148 | 118.9 | 88.2 | 208 | 167.1 | 123.9 | 268 | 215.3 | 159.6 |
| 29 | 23.3 | 17.3 | 89 | 71.5 | 53.0 | 149 | 119.7 | 88.8 | 209 | 167.9 | 124.5 | 269 | 216.1 | 160.2 |
| 30 | 24.1 | 17.9 | 90 | 72.3 | 53.6 | 150 | 120.5 | 89.4 | 210 | 168.7 | 125.1 | 270 | 216.9 | 160.8 |
| 31 | 24.9 | 18.5 | 91 | 73.1 | 54.2 | 151 | 121.3 | 90.0 | 211 | 169.5 | 125.7 | 271 | 217.7 | 161.4 |
| 32 | 25.7 | 19.1 | 92 | 73.9 | 54.8 | 152 | 122.1 | 90.5 | 212 | 170.3 | 126.3 | 272 | 218.5 | 162.0 |
| 33 | 26.5 | 19.7 | 93 | 74.7 | 55.4 | 153 | 122.9 | 91.1 | 213 | 171.1 | 126.9 | 273 | 219.3 | 162.6 |
| 34 | 27.3 | 20.3 | 94 | 75.5 | 56.0 | 154 | 123.7 | 91.7 | 214 | 171.9 | 127.5 | 274 | 220.1 | 163.2 |
| 35 | 28.1 | 20.9 | 95 | 76.3 | 56.6 | 155 | 124.5 | 92.3 | 215 | 172.7 | 128.1 | 275 | 220.9 | 163.8 |
| 36 | 28.9 | 21.4 | 96 | 77.1 | 57.2 | 156 | 125.3 | 92.9 | 216 | 173.5 | 128.7 | 276 | 221.7 | 164.4 |
| 37 | 29.7 | 22.0 | 97 | 77.9 | 57.8 | 157 | 126.1 | 93.5 | 217 | 174.3 | 129.3 | 277 | 222.5 | 165.0 |
| 38 | 30.5 | 22.6 | 98 | 78.7 | 58.4 | 158 | 126.9 | 94.1 | 218 | 175.1 | 129.9 | 278 | 223.3 | 165.6 |
| 39 | 31.3 | 23.2 | 99 | 79.5 | 59.0 | 159 | 127.7 | 94.7 | 219 | 175.9 | 130.5 | 279 | 224.1 | 166.2 |
| 40 | 32.1 | 23.8 | 100 | 80.3 | 59.6 | 160 | 128.5 | 95.3 | 220 | 176.7 | 131.1 | 280 | 224.9 | 166.8 |
| 41 | 32.9 | 24.4 | 101 | 81.1 | 60.2 | 161 | 129.3 | 95.9 | 221 | 177.5 | 131.7 | 281 | 225.7 | 167.4 |
| 42 | 33.7 | 25.0 | 102 | 81.9 | 60.8 | 162 | 130.1 | 96.5 | 222 | 178.3 | 132.2 | 282 | 226.5 | 168.0 |
| 43 | 34.5 | 25.6 | 103 | 82.7 | 61.4 | 163 | 130.9 | 97.1 | 223 | 179.1 | 132.8 | 283 | 227.3 | 168.6 |
| 44 | 35.3 | 26.2 | 104 | 83 5 | 62.0 | 164 | 131.7 | 97.7 | 224 | 179.9 | 133.4 | 284 | 228.1 | 169.2 |
| 45 | 36.1 | 26.8 | 105 | 84.3 | 62.6 | 165 | 132.5 | 98.3 | 225 | 180.7 | 134.0 | 285 | 228.9 | 169.8 |
| 46 | 36.9 | 27.4 | 106 | 85.1 | 63.1 | 166 | 133.3 | 98.9 | 226 | 181.5 | 134.6 | 286 | 229.7 | 170.4 |
| 47 | 37.7 | 28.0 | 107 | 85.9 | 63.7 | 167 | 134.1 | 99.5 | 227 | 182.3 | 135.2 | 287 | 230.5 | 171.0 |
| 48 | 38.6 | 28.6 | 108 | 86.7 | 64.3 | 168 | 134.9 | 100.1 | 228 | 183.1 | 135.8 | 288 | 231.3 | 171.6 |
| 49 | 39.4 | 29.2 | 109 | 87.5 | 64.9 | 169 | 135.7 | 100.7 | 229 | 183.9 | 136.4 | 289 | 232.1 | 172.2 |
| 50 | 40.2 | 29.8 | 110 | 88.4 | 65.5 | 170 | 136.5 | 101.3 | 230 | 184.7 | 137.0 | 290 | 232.9 | 172.8 |
| 51 | 41.0 | 30.4 | 111 | 89.2 | 66.1 | 171 | 137.3 | 101.9 | 231 | 185.5 | 137.6 | 291 | 233.7 | 173.3 |
| 52 | 41.8 | 31.0 | 112 | 90.0 | 66.7 | 172 | 138.1 | 102.5 | 232 | 186.3 | 138.2 | 292 | 234.5 | 173.9 |
| 53 | 42.6 | 31.6 | 113 | 90.8 | 67.3 | 173 | 138.9 | 103.1 | 233 | 187.1 | 138.8 | 293 | 235.3 | 174.5 |
| 54 | 43.4 | 32.2 | 114 | 91.6 | 67.9 | 174 | 139.8 | 103.7 | 234 | 187.9 | 139.4 | 294 | 236.1 | 175.1 |
| 55 | 44.2 | 32.8 | 115 | 92.4 | 68.5 | 175 | 140.6 | 104.2 | 235 | 188.8 | 140.0 | 295 | 236.9 | 175.7 |
| 56 | 45.0 | 33.4 | 116 | 93.2 | 69.1 | 176 | 141.4 | 104.8 | 236 | 189.6 | 140.6 | 296 | 237.7 | 176.3 |
| 57 | 45.8 | 34.0 | 117 | 94.0 | 69.7 | 177 | 142.2 | 105.4 | 237 | 190.4 | 141.2 | 297 | 238.5 | 176.9 |
| 58 | 46.6 | 34.6 | 118 | 94.8 | 70.3 | 178 | 143.0 | 106.0 | 238 | 191.2 | 141.8 | 298 | 239.4 | 177.5 |
| 59 | 47.4 | 35.1 | 119 | 95.6 | 70.9 | 179 | 143.8 | 106.6 | 239 | 192.0 | 142.4 | 299 | 240.2 | 178 1 |
| 60 | 48.2 | 35.7 | 120 | 96.4 | 71.5 | 180 | 144.6 | 107.2 | 240 | 192.8 | 143.0 | 300 | 241.0 | 178.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 4¾ Points.

# TABLE I.

## Difference of Latitude and Departure for 3¼ Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 47.1 | 38.7 | 121 | 93.5 | 76.8 | 181 | 139.9 | 114.8 | 241 | 186.3 | 152.9 |
| 2 | 01.5 | 01.3 | 62 | 47.9 | 39.3 | 122 | 94.3 | 77.4 | 182 | 140.7 | 115.5 | 242 | 187.1 | 153.5 |
| 3 | 02.3 | 01.9 | 63 | 48.7 | 40.0 | 123 | 95.1 | 78.0 | 183 | 141.5 | 116.1 | 243 | 187.8 | 154.2 |
| 4 | 03.1 | 02.5 | 64 | 49.5 | 40.6 | 124 | 95.8 | 78.7 | 184 | 142.2 | 116.7 | 244 | 188.6 | 154.8 |
| 5 | 03.9 | 03.2 | 65 | 50.2 | 41.2 | 125 | 96.6 | 79.3 | 185 | 143.0 | 117.4 | 245 | 189.4 | 155.4 |
| 6 | 04.6 | 03.8 | 66 | 51.0 | 41.9 | 126 | 97.4 | 79.9 | 186 | 143.8 | 118.0 | 246 | 190.2 | 156.1 |
| 7 | 05.4 | 04.4 | 67 | 51.8 | 42.5 | 127 | 98.2 | 80.6 | 187 | 144.5 | 118.6 | 247 | 190.9 | 156.7 |
| 8 | 06.2 | 05.1 | 68 | 52.6 | 43.1 | 128 | 98.9 | 81.2 | 188 | 145.3 | 119.3 | 248 | 191.7 | 157.3 |
| 9 | 07.0 | 05.7 | 69 | 53.3 | 43.8 | 129 | 99.7 | 81.8 | 189 | 146.1 | 119.9 | 249 | 192.5 | 158.0 |
| 10 | 07.7 | 06.3 | 70 | 54.1 | 44.4 | 130 | 100.5 | 82.5 | 190 | 146.9 | 120.5 | 250 | 193.2 | 158.6 |
| 11 | 08.5 | 07.0 | 71 | 54.9 | 45.0 | 131 | 101.3 | 83.1 | 191 | 147.6 | 121.2 | 251 | 194.0 | 159.2 |
| 12 | 09.3 | 07.6 | 72 | 55.7 | 45.7 | 132 | 102.0 | 83.7 | 192 | 148.4 | 121.8 | 252 | 194.8 | 159.9 |
| 13 | 10.0 | 08.2 | 73 | 56.4 | 46.3 | 133 | 102.8 | 84.4 | 193 | 149.2 | 122.4 | 253 | 195.6 | 160.5 |
| 14 | 10.8 | 08.9 | 74 | 57.2 | 46.9 | 134 | 103.6 | 85.0 | 194 | 150.0 | 123.1 | 254 | 196.3 | 161.1 |
| 15 | 11.6 | 09.5 | 75 | 58.0 | 47.6 | 135 | 104.4 | 85.6 | 195 | 150.7 | 123.7 | 255 | 197.1 | 161.8 |
| 16 | 12.4 | 10.1 | 76 | 58.7 | 48.2 | 136 | 105.1 | 86.3 | 196 | 151.5 | 124.3 | 256 | 197.9 | 162.4 |
| 17 | 13.1 | 10.8 | 77 | 59.5 | 48.8 | 137 | 105.9 | 86.9 | 197 | 152.3 | 125.0 | 257 | 198.7 | 163.0 |
| 18 | 13.9 | 11.4 | 78 | 60.3 | 49.5 | 138 | 106.7 | 87.5 | 198 | 153.1 | 125.6 | 258 | 199.4 | 163.7 |
| 19 | 14.7 | 12.0 | 79 | 61.1 | 50.1 | 139 | 107.4 | 88.2 | 199 | 153.8 | 126.2 | 259 | 200.2 | 164.3 |
| 20 | 15.5 | 12.7 | 80 | 61.8 | 50.7 | 140 | 108.2 | 88.8 | 200 | 154.6 | 126.9 | 260 | 201.0 | 164.9 |
| 21 | 16.2 | 13.3 | 81 | 62.6 | 51.4 | 141 | 109.0 | 89.4 | 201 | 155.4 | 127.5 | 261 | 201.8 | 165.6 |
| 22 | 17.0 | 14.0 | 82 | 63.4 | 52.0 | 142 | 109.8 | 90.1 | 202 | 156.1 | 128.1 | 262 | 202.5 | 166.2 |
| 23 | 17.8 | 14.6 | 83 | 64.2 | 52.7 | 143 | 110.5 | 90.7 | 203 | 156.9 | 128.8 | 263 | 203.3 | 166.8 |
| 24 | 18.6 | 15.2 | 84 | 64.9 | 53.3 | 144 | 111.3 | 91.3 | 204 | 157.7 | 129.4 | 264 | 204.1 | 167.5 |
| 25 | 19.3 | 15.9 | 85 | 65.7 | 53.9 | 145 | 112.1 | 92.0 | 205 | 158.5 | 130.0 | 265 | 204.8 | 168.1 |
| 26 | 20.1 | 16.5 | 86 | 66.5 | 54.6 | 146 | 112.9 | 92.6 | 206 | 159.2 | 130.7 | 266 | 205.6 | 168.7 |
| 27 | 20.9 | 17.1 | 87 | 67.2 | 55.2 | 147 | 113.6 | 93.3 | 207 | 160.0 | 131.3 | 267 | 206.4 | 169.4 |
| 28 | 21.6 | 17.8 | 88 | 68.0 | 55.8 | 148 | 114.4 | 93.9 | 208 | 160.8 | 132.0 | 268 | 207.2 | 170.0 |
| 29 | 22.4 | 18.4 | 89 | 68.8 | 56.5 | 149 | 115.2 | 94.5 | 209 | 161.6 | 132.6 | 269 | 207.9 | 170.6 |
| 30 | 23.2 | 19.0 | 90 | 69.6 | 57.1 | 150 | 115.9 | 95.2 | 210 | 162.3 | 133.2 | 270 | 208.7 | 171.3 |
| 31 | 24.0 | 19.7 | 91 | 70.3 | 57.7 | 151 | 116.7 | 95.8 | 211 | 163.1 | 133.9 | 271 | 209.5 | 171.9 |
| 32 | 24.7 | 20.3 | 92 | 71.1 | 58.4 | 152 | 117.5 | 96.4 | 212 | 163.9 | 134.5 | 272 | 210.3 | 172.6 |
| 33 | 25.5 | 20.9 | 93 | 71.9 | 59.0 | 153 | 118.3 | 97.1 | 213 | 164.6 | 135.1 | 273 | 211.0 | 173.2 |
| 34 | 26.3 | 21.6 | 94 | 72.7 | 59.6 | 154 | 119.0 | 97.7 | 214 | 165.4 | 135.8 | 274 | 211.8 | 173.8 |
| 35 | 27.1 | 22.2 | 95 | 73.4 | 60.3 | 155 | 119.8 | 98.3 | 215 | 166.2 | 136.4 | 275 | 212.6 | 174.5 |
| 36 | 27.8 | 22.8 | 96 | 74.2 | 60.9 | 156 | 120.6 | 99.0 | 216 | 167.0 | 137.0 | 276 | 213.3 | 175.1 |
| 37 | 28.6 | 23.5 | 97 | 75.0 | 61.5 | 157 | 121.4 | 99.6 | 217 | 167.7 | 137.7 | 277 | 214.1 | 175.7 |
| 38 | 29.4 | 24.1 | 98 | 75.7 | 62.2 | 158 | 122.1 | 100.2 | 218 | 168.5 | 138.3 | 278 | 214.9 | 176.4 |
| 39 | 30.1 | 24.7 | 99 | 76.5 | 62.8 | 159 | 122.9 | 100.9 | 219 | 169.3 | 138.9 | 279 | 215.7 | 177.0 |
| 40 | 30.9 | 25.4 | 100 | 77.3 | 63.4 | 160 | 123.7 | 101.5 | 220 | 170.1 | 139.6 | 280 | 216.4 | 177.6 |
| 41 | 31.7 | 26.0 | 101 | 78.1 | 64.1 | 161 | 124.4 | 102.1 | 221 | 170.8 | 140.2 | 281 | 217.2 | 178.3 |
| 42 | 32.5 | 26.6 | 102 | 78.8 | 64.7 | 162 | 125.2 | 102.8 | 222 | 171.6 | 140.8 | 282 | 218.0 | 178.9 |
| 43 | 33.2 | 27.3 | 103 | 79.6 | 65.3 | 163 | 126.0 | 103.4 | 223 | 172.4 | 141.5 | 283 | 218.8 | 179.5 |
| 44 | 34.0 | 27.9 | 104 | 80.4 | 66.0 | 164 | 126.8 | 104.0 | 224 | 173.1 | 142.1 | 284 | 219.5 | 180.2 |
| 45 | 34.8 | 28.5 | 105 | 81.2 | 66.6 | 165 | 127.5 | 104.7 | 225 | 173.9 | 142.7 | 285 | 220.3 | 180.8 |
| 46 | 35.6 | 29.2 | 106 | 81.9 | 67.2 | 166 | 128.3 | 105.3 | 226 | 174.7 | 143.4 | 286 | 221.1 | 181.4 |
| 47 | 36.3 | 29.8 | 107 | 82.7 | 67.9 | 167 | 129.1 | 105.9 | 227 | 175.5 | 144.0 | 287 | 221.8 | 182.1 |
| 48 | 37.1 | 30.4 | 108 | 83.5 | 68.5 | 168 | 129.9 | 106.6 | 228 | 176.2 | 144.6 | 288 | 222.6 | 182.7 |
| 49 | 37.9 | 31.1 | 109 | 84.3 | 69.1 | 169 | 130.6 | 107.2 | 229 | 177.0 | 145.3 | 289 | 223.4 | 183.3 |
| 50 | 38.6 | 31.7 | 110 | 85.0 | 69.8 | 170 | 131.4 | 107.8 | 230 | 177.8 | 145.9 | 290 | 224.2 | 184.0 |
| 51 | 39.4 | 32.3 | 111 | 85.8 | 70.4 | 171 | 132.2 | 108.5 | 231 | 178.6 | 146.5 | 291 | 224.9 | 184.6 |
| 52 | 40.2 | 33.0 | 112 | 86.6 | 71.0 | 172 | 133.0 | 109.1 | 232 | 179.3 | 147.2 | 292 | 225.7 | 185.2 |
| 53 | 41.0 | 33.6 | 113 | 87.3 | 71.7 | 173 | 133.7 | 109.7 | 233 | 180.1 | 147.8 | 293 | 226.5 | 185.9 |
| 54 | 41.7 | 34.3 | 114 | 88.1 | 72.3 | 174 | 134.5 | 110.4 | 234 | 180.9 | 148.4 | 294 | 227.3 | 186.5 |
| 55 | 42.5 | 34.9 | 115 | 88.9 | 73.0 | 175 | 135.3 | 111.0 | 235 | 181.7 | 149.1 | 295 | 228.0 | 187.1 |
| 56 | 43.3 | 35.5 | 116 | 89.7 | 73.6 | 176 | 136.0 | 111.6 | 236 | 182.4 | 149 7 | 296 | 228.8 | 187.8 |
| 57 | 44.1 | 36.2 | 117 | 90.4 | 74.2 | 177 | 136.8 | 112.3 | 237 | 183.2 | 150.3 | 297 | 229.6 | 188.4 |
| 58 | 44.8 | 36.8 | 118 | 91.2 | 74.9 | 178 | 137.6 | 112.9 | 238 | 184.0 | 151.0 | 298 | 230.4 | 189.0 |
| 59 | 45.6 | 37.4 | 119 | 92.0 | 75.5 | 179 | 138.4 | 113.6 | 239 | 184.7 | 151.6 | 299 | 231.1 | 189.7 |
| 60 | 46.4 | 38.1 | 120 | 92.8 | 76.1 | 180 | 139.1 | 114.2 | 240 | 185.5 | 152.3 | 300 | 231.9 | 190.3 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE I.

## Difference of Latitude and Departure for 3¾ Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.7 | 00.7 | 61 | 45.2 | 41.0 | 121 | 89.6 | 81.3 | 181 | 134.1 | 121.5 | 241 | 178.6 | 161.8 |
| 2 | 01.5 | 01.3 | 62 | 45.9 | 41.6 | 122 | 90.4 | 81.9 | 182 | 134.8 | 122.2 | 242 | 179.3 | 162.5 |
| 3 | 02.2 | 02.0 | 63 | 46.7 | 42.3 | 123 | 91.1 | 82.6 | 183 | 135.6 | 122.9 | 243 | 180.0 | 163.2 |
| 4 | 03.0 | 02.7 | 64 | 47.4 | 43.0 | 124 | 91.9 | 83.3 | 184 | 136.3 | 123.6 | 244 | 180.8 | 163.8 |
| 5 | 03.7 | 03.4 | 65 | 48.2 | 43.6 | 125 | 92.6 | 83.9 | 185 | 137.1 | 124.2 | 245 | 181.5 | 164.5 |
| 6 | 04.4 | 04.0 | 66 | 48.9 | 44.3 | 126 | 93.4 | 84.6 | 186 | 137.8 | 124.9 | 246 | 182.3 | 165.2 |
| 7 | 05.2 | 04.7 | 67 | 49.6 | 45.0 | 127 | 94.1 | 85.3 | 187 | 138.6 | 125.6 | 247 | 183.0 | 165.9 |
| 8 | 05.9 | 05.4 | 68 | 50.4 | 45.7 | 128 | 94.8 | 86.0 | 188 | 139.3 | 126.2 | 248 | 183.8 | 166.5 |
| 9 | 06.7 | 06.0 | 69 | 51.1 | 46.3 | 129 | 95.6 | 86.6 | 189 | 140·0 | 126.9 | 249 | 184.5 | 167.2 |
| 10 | 07.4 | 06.7 | 70 | 51.9 | 47.0 | 130 | 96.3 | 87.3 | 190 | 140.8 | 127.6 | 250 | 185.2 | 167.9 |
| 11 | 08.2 | 07.4 | 71 | 52.6 | 47.7 | 131 | 97.1 | 88.0 | 191 | 141.5 | 128.3 | 251 | 186.0 | 168.5 |
| 12 | 08.9 | 08.1 | 72 | 53.3 | 48.3 | 132 | 97.8 | 88.6 | 192 | 142.3 | 128.9 | 252 | 186.7 | 169.2 |
| 13 | 09.6 | 08.7 | 73 | 54.1 | 49.0 | 133 | 98.5 | 89.3 | 193 | 143.0 | 129.6 | 253 | 187.5 | 169.9 |
| 14 | 10.4 | 09.4 | 74 | 54.8 | 49.7 | 134 | 99.3 | 90.0 | 194 | 143.7 | 130.3 | 254 | 188.2 | 170.6 |
| 15 | 11.1 | 10.1 | 75 | 55.6 | 50.4 | 135 | 100.0 | 90.7 | 195 | 144.5 | 130.9 | 255 | 188.9 | 171.2 |
| 16 | 11.9 | 10.7 | 76 | 56.3 | 51.0 | 136 | 100.8 | 91.3 | 196 | 145.2 | 131.6 | 256 | 189.7 | 171.9 |
| 17 | 12.6 | 11.4 | 77 | 57.0 | 51.7 | 137 | 101.5 | 92.0 | 197 | 146.0 | 132.3 | 257 | 190.4 | 172.6 |
| 18 | 13.3 | 12.1 | 78 | 57.8 | 52.4 | 138 | 102.2 | 92.7 | 198 | 146.7 | 133.0 | 258 | 191.2 | 173.2 |
| 19 | 14.1 | 12.8 | 79 | 58.5 | 53.0 | 139 | 103.0 | 93.3 | 199 | 147.4 | 133.6 | 259 | 191.9 | 173.9 |
| 20 | 14.8 | 13.4 | 80 | 59.3 | 53.7 | 140 | 103.7 | 94.0 | 200 | 148.2 | 134.3 | 260 | 192.6 | 174.6 |
| 21 | 15.6 | 14.1 | 81 | 60.0 | 54.4 | 141 | 104.5 | 94.7 | 201 | 148.9 | 135.0 | 261 | 193.4 | 175.3 |
| 22 | 16.3 | 14.8 | 82 | 60.8 | 55.1 | 142 | 105.2 | 95.4 | 202 | 149.7 | 135.6 | 262 | 194.1 | 175.9 |
| 23 | 17.0 | 15.4 | 83 | 61.5 | 55.7 | 143 | 106.0 | 96.0 | 203 | 150.4 | 136.3 | 263 | 194.9 | 176.6 |
| 24 | 17.8 | 16.1 | 84 | 62.2 | 56.4 | 144 | 106.7 | 96.7 | 204 | 151.1 | 137.0 | 264 | 195.6 | 177.3 |
| 25 | 18.5 | 16.8 | 85 | 63.0 | 57.1 | 145 | 107.4 | 97.4 | 205 | 151.9 | 137.7 | 265 | 196.3 | 178.0 |
| 26 | 19.3 | 17.5 | 86 | 63.7 | 57.7 | 146 | 108.2 | 98.0 | 206 | 152.6 | 138.3 | 266 | 197.1 | 178.6 |
| 27 | 20.0 | 18.1 | 87 | 64.5 | 58.4 | 147 | 108.9 | 98.7 | 207 | 153.4 | 139.0 | 267 | 197.8 | 179.3 |
| 28 | 20.7 | 18.8 | 88 | 65.2 | 59.1 | 148 | 109.7 | 99.4 | 208 | 154.1 | 139.7 | 268 | 198.6 | 180.0 |
| 29 | 21.5 | 19.5 | 89 | 65.9 | 59.8 | 149 | 110.4 | 100.1 | 209 | 154.9 | 140.3 | 269 | 199.3 | 180.6 |
| 30 | 22.2 | 20.1 | 90 | 66.7 | 60.4 | 150 | 111.1 | 100.7 | 210 | 155.6 | 141.0 | 270 | 200.1 | 181.3 |
| 31 | 23.0 | 20.8 | 91 | 67.4 | 61.1 | 151 | 111.9 | 101.4 | 211 | 156.3 | 141.7 | 271 | 200.8 | 182.0 |
| 32 | 23.7 | 21.5 | 92 | 68.2 | 61.8 | 152 | 112.6 | 102.1 | 212 | 157.1 | 142.4 | 272 | 201.5 | 182.7 |
| 33 | 24.4 | 22.2 | 93 | 68.9 | 62.4 | 153 | 113.4 | 102.7 | 213 | 157.8 | 143.0 | 273 | 202.3 | 183.3 |
| 34 | 25.2 | 22.8 | 94 | 69.6 | 63.1 | 154 | 114.1 | 103.4 | 214 | 158.6 | 143.7 | 274 | 203.0 | 184.0 |
| 35 | 25.9 | 23.5 | 95 | 70.4 | 63.8 | 155 | 114.8 | 104.1 | 215 | 159.3 | 144.4 | 275 | 203.8 | 184.7 |
| 36 | 26.7 | 24.2 | 96 | 71.1 | 64.5 | 156 | 115.6 | 104.8 | 216 | 160.0 | 145.0 | 276 | 204.5 | 185.3 |
| 37 | 27.4 | 24.8 | 97 | 71.9 | 65.1 | 157 | 116.3 | 105.4 | 217 | 160.8 | 145.7 | 277 | 205.2 | 186.0 |
| 38 | 28.2 | 25.5 | 98 | 72.6 | 65.8 | 158 | 117.1 | 106.1 | 218 | 161.5 | 146.4 | 278 | 206.0 | 186.7 |
| 39 | 28.9 | 26.2 | 99 | 73.3 | 66.5 | 159 | 117.8 | 106.8 | 219 | 162.3 | 147.1 | 279 | 206.7 | 187.4 |
| 40 | 29.6 | 26.9 | 100 | 74.1 | 67.2 | 160 | 118.5 | 107.4 | 220 | 163.0 | 147.7 | 280 | 207.5 | 188.0 |
| 41 | 30.4 | 27.5 | 101 | 74.8 | 67.8 | 161 | 119.3 | 108.1 | 221 | 163.7 | 148.4 | 281 | 208.2 | 188.7 |
| 42 | 31.1 | 28.2 | 102 | 75.6 | 68.5 | 162 | 120.0 | 108.8 | 222 | 164.5 | 149.1 | 282 | 208.9 | 189.4 |
| 43 | 31.9 | 28.9 | 103 | 76.3 | 69.2 | 163 | 120.8 | 109.5 | 223 | 165.2 | 149.7 | 283 | 209.7 | 190.0 |
| 44 | 32.6 | 29.5 | 104 | 77.1 | 69.8 | 164 | 121.5 | 110.1 | 224 | 166.0 | 150.4 | 284 | 210.4 | 190.7 |
| 45 | 33.3 | 30.2 | 105 | 77.8 | 70.5 | 165 | 122.3 | 110.8 | 225 | 166.7 | 151.1 | 285 | 211.2 | 191.4 |
| 46 | 34.1 | 30.9 | 106 | 78.5 | 71.2 | 166 | 123.0 | 111.5 | 226 | 167.4 | 151.8 | 286 | 211.9 | 192.1 |
| 47 | 34.8 | 31.6 | 107 | 79.3 | 71.8 | 167 | 123.7 | 112.1 | 227 | 168.2 | 152.4 | 287 | 212.6 | 192.7 |
| 48 | 35.6 | 32.2 | 108 | 80.0 | 72.5 | 168 | 124.5 | 112.8 | 228 | 168.9 | 153.1 | 288 | 213.4 | 193.4 |
| 49 | 36.3 | 32.9 | 109 | 80.8 | 73.2 | 169 | 125.2 | 113.5 | 229 | 169.7 | 153.8 | 289 | 214.1 | 194.1 |
| 50 | 37.0 | 33.6 | 110 | 81.5 | 73.9 | 170 | 126.0 | 114.2 | 230 | 170.4 | 154.5 | 290 | 214.9 | 194.7 |
| 51 | 37.8 | 34.2 | 111 | 82.2 | 74.5 | 171 | 126.7 | 114.8 | 231 | 171.2 | 155.1 | 291 | 215.6 | 195.4 |
| 52 | 38.5 | 34.9 | 112 | 83.0 | 75.2 | 172 | 127.4 | 115.5 | 232 | 171.9 | 155.8 | 292 | 216.4 | 196.1 |
| 53 | 39.3 | 35.6 | 113 | 83.7 | 75.9 | 173 | 128.2 | 116.2 | 233 | 172.6 | 156.5 | 293 | 217.1 | 196.8 |
| 54 | 40.0 | 36.3 | 114 | 84.5 | 76.5 | 174 | 128.9 | 116.8 | 234 | 173.4 | 157.1 | 294 | 217.8 | 197.4 |
| 55 | 40.7 | 36.9 | 115 | 85.2 | 77.2 | 175 | 129.7 | 117.5 | 235 | 174.1 | 157.8 | 295 | 218.6 | 198.1 |
| 56 | 41.5 | 37.6 | 116 | 85.9 | 77.9 | 176 | 130.4 | 118.2 | 236 | 174.9 | 158.5 | 296 | 219.3 | 198.8 |
| 57 | 42.2 | 38.3 | 117 | 86.7 | 78.6 | 177 | 131.1 | 118.9 | 237 | 175.6 | 159.1 | 297 | 220.1 | 199.4 |
| 58 | 43.0 | 38.9 | 118 | 87.4 | 79.2 | 178 | 131.9 | 119.5 | 238 | 176.3 | 159.8 | 298 | 220.8 | 200.1 |
| 59 | 43.7 | 39.6 | 119 | 88.2 | 79.9 | 179 | 132.6 | 120.2 | 239 | 177.1 | 160.5 | 299 | 221.5 | 200.8 |
| 60 | 44.5 | 40.3 | 120 | 88.9 | 80.6 | 180 | 133.4 | 120.9 | 240 | 177.8 | 161.2 | 300 | 222.3 | 201.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE I.

## Difference of Latitude and Departure for 4 Points.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.7 | 00.7 | 61 | 43.1 | 43.1 | 121 | 85.6 | 85.6 | 181 | 128.0 | 128.0 | 241 | 170.4 | 170.4 |
| 2 | 01.4 | 01.4 | 62 | 43.8 | 43.8 | 122 | 86.3 | 86.3 | 182 | 128.7 | 128.7 | 242 | 171.1 | 171.1 |
| 3 | 02.1 | 02.1 | 63 | 44.5 | 44.5 | 123 | 87.0 | 87.0 | 183 | 129.4 | 129.4 | 243 | 171.8 | 171.8 |
| 4 | 02.8 | 02.8 | 64 | 45.3 | 45.3 | 124 | 87.7 | 87.7 | 184 | 130.1 | 130.1 | 244 | 172.5 | 172.5 |
| 5 | 03.5 | 03.5 | 65 | 46.0 | 46.0 | 125 | 88.4 | 88.4 | 185 | 130.8 | 130.8 | 245 | 173.2 | 173.2 |
| 6 | 04.2 | 04.2 | 66 | 46.7 | 46.7 | 126 | 89.1 | 89.1 | 186 | 131.5 | 131.5 | 246 | 173.9 | 173.9 |
| 7 | 04.9 | 04.9 | 67 | 47.4 | 47.4 | 127 | 89.8 | 89.8 | 187 | 132.2 | 132.2 | 247 | 174.7 | 174.7 |
| 8 | 05.7 | 05.7 | 68 | 48.1 | 48.1 | 128 | 90.5 | 90.5 | 188 | 132.9 | 132.9 | 248 | 175.4 | 175.4 |
| 9 | 06.4 | 06.4 | 69 | 48.8 | 48.8 | 129 | 91.2 | 91.2 | 189 | 133.6 | 133.6 | 249 | 176.1 | 176.1 |
| 10 | 07.1 | 07.1 | 70 | 49.5 | 49.5 | 130 | 91.9 | 91.9 | 190 | 134.3 | 134.3 | 250 | 176.8 | 176.8 |
| 11 | 07.8 | 07.8 | 71 | 50.2 | 50.2 | 131 | 92.6 | 92.6 | 191 | 135.1 | 135.1 | 251 | 177.5 | 177.5 |
| 12 | 08.5 | 08.5 | 72 | 50.9 | 50.9 | 132 | 93.3 | 93.3 | 192 | 135.8 | 135.8 | 252 | 178.2 | 178.2 |
| 13 | 09.2 | 09.2 | 73 | 51.6 | 51.6 | 133 | 94.0 | 94.0 | 193 | 136.5 | 136.5 | 253 | 178.9 | 178.9 |
| 14 | 09.9 | 09.9 | 74 | 52.3 | 52.3 | 134 | 94.8 | 94.8 | 194 | 137.2 | 137.2 | 254 | 179.6 | 179.6 |
| 15 | 10.6 | 10.6 | 75 | 53.0 | 53.0 | 135 | 95.5 | 95.5 | 195 | 137.9 | 137.9 | 255 | 180.3 | 180.3 |
| 16 | 11.3 | 11.3 | 76 | 53.7 | 53.7 | 136 | 96.2 | 96.2 | 196 | 138.6 | 138.6 | 256 | 181.0 | 181.0 |
| 17 | 12.0 | 12.0 | 77 | 54.4 | 54.4 | 137 | 96.9 | 96.9 | 197 | 139.3 | 139.3 | 257 | 181.7 | 181.7 |
| 18 | 12.7 | 12.7 | 78 | 55.2 | 55.2 | 138 | 97.6 | 97.6 | 198 | 140.0 | 140.0 | 258 | 182.4 | 182.4 |
| 19 | 13.4 | 13.4 | 79 | 55.9 | 55.9 | 139 | 98.3 | 98.3 | 199 | 140.7 | 140.7 | 259 | 183.1 | 183.1 |
| 20 | 14.1 | 14.1 | 80 | 56.6 | 56.6 | 140 | 99.0 | 99.0 | 200 | 141.4 | 141.4 | 260 | 183.8 | 183.8 |
| 21 | 14.8 | 14.8 | 81 | 57.3 | 57.3 | 141 | 99.7 | 99.7 | 201 | 142.1 | 142.1 | 261 | 184.6 | 184.6 |
| 22 | 15.6 | 15.6 | 82 | 58.0 | 58.0 | 142 | 100.4 | 100.4 | 202 | 142.8 | 142.8 | 262 | 185.3 | 185.3 |
| 23 | 16.3 | 16.3 | 83 | 58.7 | 58.7 | 143 | 101.1 | 101.1 | 203 | 143.5 | 143.5 | 263 | 186.0 | 186.0 |
| 24 | 17.0 | 17.0 | 84 | 59.4 | 59.4 | 144 | 101.8 | 101.8 | 204 | 144.2 | 144.2 | 264 | 186.7 | 186.7 |
| 25 | 17.7 | 17.7 | 85 | 60.1 | 60.1 | 145 | 102.5 | 102.5 | 205 | 145.0 | 145.0 | 265 | 187.4 | 187.4 |
| 26 | 18.4 | 18.4 | 86 | 60.8 | 60.8 | 146 | 103.2 | 103.2 | 206 | 145.7 | 145.7 | 266 | 188.1 | 188.1 |
| 27 | 19.1 | 19.1 | 87 | 61.5 | 61.5 | 147 | 103.9 | 103.9 | 207 | 146.4 | 146.4 | 267 | 188.8 | 188.8 |
| 28 | 19.8 | 19.8 | 88 | 62.2 | 62.2 | 148 | 104.7 | 104.7 | 208 | 147.1 | 147.1 | 268 | 189.5 | 189.5 |
| 29 | 20.5 | 20.5 | 89 | 62.9 | 62.9 | 149 | 105.4 | 105.4 | 209 | 147.8 | 147.8 | 269 | 190.2 | 190.2 |
| 30 | 21.2 | 21.2 | 90 | 63.6 | 63.6 | 150 | 106.1 | 106.1 | 210 | 148.5 | 148.5 | 270 | 190.9 | 190.9 |
| 31 | 21.9 | 21.9 | 91 | 64.3 | 64.3 | 151 | 106.8 | 106.8 | 211 | 149.2 | 149.2 | 271 | 191.6 | 191.6 |
| 32 | 22.6 | 22.6 | 92 | 65.1 | 65.1 | 152 | 107.5 | 107.5 | 212 | 149.9 | 149.9 | 272 | 192.3 | 192.3 |
| 33 | 23.3 | 23.3 | 93 | 65.8 | 65.8 | 153 | 108.2 | 108.2 | 213 | 150.6 | 150.6 | 273 | 193.0 | 193.0 |
| 34 | 24.0 | 24.0 | 94 | 66.5 | 66.5 | 154 | 108.9 | 108.9 | 214 | 151.3 | 151.3 | 274 | 193.7 | 193.7 |
| 35 | 24.7 | 24.7 | 95 | 67.2 | 67.2 | 155 | 109.6 | 109.6 | 215 | 152.0 | 152.0 | 275 | 194.5 | 194.5 |
| 36 | 25.5 | 25.5 | 96 | 67.9 | 67.9 | 156 | 110.3 | 110.3 | 216 | 152.7 | 152.7 | 276 | 195.2 | 195.2 |
| 37 | 26.2 | 26.2 | 97 | 68.6 | 68.6 | 157 | 111.0 | 111.0 | 217 | 153.4 | 153.4 | 277 | 195.9 | 195.9 |
| 38 | 26.9 | 26.9 | 98 | 69.3 | 69.3 | 158 | 111.7 | 111.7 | 218 | 154.1 | 154.1 | 278 | 196.6 | 196.6 |
| 39 | 27.6 | 27.6 | 99 | 70.0 | 70.0 | 159 | 112.4 | 112.4 | 219 | 154.9 | 154.9 | 279 | 197.3 | 197.3 |
| 40 | 28.3 | 28.3 | 100 | 70.7 | 70.7 | 160 | 113.1 | 113.1 | 220 | 155.6 | 155.6 | 280 | 198.0 | 198.0 |
| 41 | 29.0 | 29.0 | 101 | 71.4 | 71.4 | 161 | 113.8 | 113.8 | 221 | 156.3 | 156.3 | 281 | 198.7 | 198.7 |
| 42 | 29.7 | 29.7 | 102 | 72.1 | 72.1 | 162 | 114.5 | 114.5 | 222 | 157.0 | 157.0 | 282 | 199.4 | 199.4 |
| 43 | 30.4 | 30.4 | 103 | 72.8 | 72.8 | 163 | 115.3 | 115.3 | 223 | 157.7 | 157.7 | 283 | 200.1 | 200.1 |
| 44 | 31.1 | 31.1 | 104 | 73.5 | 73.5 | 164 | 116.0 | 116.0 | 224 | 158.4 | 158.4 | 284 | 200.8 | 200.8 |
| 45 | 31.8 | 31.8 | 105 | 74.2 | 74.2 | 165 | 116.7 | 116.7 | 225 | 159.1 | 159.1 | 285 | 201.5 | 201.5 |
| 46 | 32.5 | 32.5 | 106 | 75.0 | 75.0 | 166 | 117.4 | 117.4 | 226 | 159.8 | 159.8 | 286 | 202.2 | 202.2 |
| 47 | 33.2 | 33.2 | 107 | 75.7 | 75.7 | 167 | 118.1 | 118.1 | 227 | 160.5 | 160.5 | 287 | 202.9 | 202.9 |
| 48 | 33.9 | 33.9 | 108 | 76.4 | 76.4 | 168 | 118.8 | 118.8 | 228 | 161.2 | 161.2 | 288 | 203.6 | 203.6 |
| 49 | 34.6 | 34.6 | 109 | 77.1 | 77.1 | 169 | 119.5 | 119.5 | 229 | 161.9 | 161.9 | 289 | 204.3 | 204.3 |
| 50 | 35.4 | 35.4 | 110 | 77.8 | 77.8 | 170 | 120.2 | 120.2 | 230 | 162.6 | 162.6 | 290 | 205.1 | 205.1 |
| 51 | 36.1 | 36.1 | 111 | 78.5 | 78.5 | 171 | 120.9 | 120.9 | 231 | 163.3 | 163.3 | 291 | 205.8 | 205.8 |
| 52 | 36.8 | 36.8 | 112 | 79.2 | 79.2 | 172 | 121.6 | 121.6 | 232 | 164.0 | 164.0 | 292 | 206.5 | 206.5 |
| 53 | 37.5 | 37.5 | 113 | 79.9 | 79.9 | 173 | 122.3 | 122.3 | 233 | 164.8 | 164.8 | 293 | 207.2 | 207.2 |
| 54 | 38.2 | 38.2 | 114 | 80.6 | 80.6 | 174 | 123.0 | 123.0 | 234 | 165.5 | 165.5 | 294 | 207.9 | 207.9 |
| 55 | 38.9 | 38.9 | 115 | 81.3 | 81.3 | 175 | 123.7 | 123.7 | 235 | 166.2 | 166.2 | 295 | 208.6 | 208.6 |
| 56 | 39.6 | 39.6 | 116 | 82.0 | 82.0 | 176 | 124.4 | 124.4 | 236 | 166.9 | 166.9 | 296 | 209.3 | 209.3 |
| 57 | 40.3 | 40.3 | 117 | 82.7 | 82.7 | 177 | 125.2 | 125.2 | 237 | 167.6 | 167.6 | 297 | 210.0 | 210.0 |
| 58 | 41.0 | 41.0 | 118 | 83.4 | 83.4 | 178 | 125.9 | 125.9 | 238 | 168.3 | 168.3 | 298 | 210.7 | 210.7 |
| 59 | 41.7 | 41.7 | 119 | 84.1 | 84.1 | 179 | 126.6 | 126.6 | 239 | 169.0 | 169.0 | 299 | 211.4 | 211.4 |
| 60 | 42.4 | 42.4 | 120 | 84.8 | 84.8 | 180 | 127.3 | 127.3 | 240 | 169.7 | 169.7 | 300 | 212.1 | 212.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 1 Degree.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.0 | 61 | 61.0 | 01.1 | 121 | 121.0 | 02.1 | 181 | 181.0 | 03.2 | 241 | 241.0 | 04.2 |
| 2 | 02.0 | 00.0 | 62 | 62.0 | 01.1 | 122 | 122.0 | 02.1 | 182 | 182.0 | 03.2 | 242 | 242.0 | 04.2 |
| 3 | 03.0 | 00.1 | 63 | 63.0 | 01.1 | 123 | 123.0 | 02.1 | 183 | 183.0 | 03.2 | 243 | 243.0 | 04.2 |
| 4 | 04.0 | 00.1 | 64 | 64.0 | 01.1 | 124 | 124.0 | 02.2 | 184 | 184.0 | 03.2 | 244 | 244.0 | 04.3 |
| 5 | 05.0 | 00.1 | 65 | 65.0 | 01.1 | 125 | 125.0 | 02.2 | 185 | 185.0 | 03.2 | 245 | 245.0 | 04.3 |
| 6 | 06.0 | 00.1 | 66 | 66.0 | 01.2 | 126 | 126.0 | 02.2 | 186 | 186.0 | 03.2 | 246 | 246.0 | 04.3 |
| 7 | 07.0 | 00.1 | 67 | 67.0 | 01.2 | 127 | 127.0 | 02.2 | 187 | 187.0 | 03.3 | 247 | 247.0 | 04.3 |
| 8 | 08.0 | 00.1 | 68 | 68.0 | 01.2 | 128 | 128.0 | 02.2 | 188 | 188.0 | 03.3 | 248 | 248.0 | 04.3 |
| 9 | 09.0 | 00.2 | 69 | 69.0 | 01.2 | 129 | 129.0 | 02.2 | 189 | 189.0 | 03.3 | 249 | 249.0 | 04.3 |
| 10 | 10.0 | 00.2 | 70 | 70.0 | 01.2 | 130 | 130.0 | 02.3 | 190 | 190.0 | 03.3 | 250 | 250.0 | 04.4 |
| 11 | 11.0 | 00.2 | 71 | 71.0 | 01.2 | 131 | 131.0 | 02.3 | 191 | 191.0 | 03.3 | 251 | 251.0 | 04.4 |
| 12 | 12.0 | 00.2 | 72 | 72.0 | 01.3 | 132 | 132.0 | 02.3 | 192 | 192.0 | 03.4 | 252 | 252.0 | 04.4 |
| 13 | 13.0 | 00.2 | 73 | 73.0 | 01.3 | 133 | 133.0 | 02.3 | 193 | 193.0 | 03.4 | 253 | 253.0 | 04.4 |
| 14 | 14.0 | 00.2 | 74 | 74.0 | 01.3 | 134 | 134.0 | 02.3 | 194 | 194.0 | 03.4 | 254 | 254.0 | 04.4 |
| 15 | 15.0 | 00.3 | 75 | 75.0 | 01.3 | 135 | 135.0 | 02.4 | 195 | 195.0 | 03.4 | 255 | 255.0 | 04.4 |
| 16 | 16.0 | 00.3 | 76 | 76.0 | 01.3 | 136 | 136.0 | 02.4 | 196 | 196.0 | 03.4 | 256 | 256.0 | 04.5 |
| 17 | 17.0 | 00.3 | 77 | 77.0 | 01.3 | 137 | 137.0 | 02.4 | 197 | 197.0 | 03.4 | 257 | 257.0 | 04.5 |
| 18 | 18.0 | 00.3 | 78 | 78.0 | 01.4 | 138 | 138.0 | 02.4 | 198 | 198.0 | 03.5 | 258 | 258.0 | 04.5 |
| 19 | 19.0 | 00.3 | 79 | 79.0 | 01.4 | 139 | 139.0 | 02.4 | 199 | 199.0 | 03.5 | 259 | 259.0 | 04.5 |
| 20 | 20.0 | 00.3 | 80 | 80.0 | 01.4 | 140 | 140.0 | 02.4 | 200 | 200.0 | 03.5 | 260 | 260.0 | 04.5 |
| 21 | 21.0 | 00.4 | 81 | 81.0 | 01.4 | 141 | 141.0 | 02.5 | 201 | 201.0 | 03.5 | 261 | 261.0 | 04.5 |
| 22 | 22.0 | 00.4 | 82 | 82.0 | 01.4 | 142 | 142.0 | 02.5 | 202 | 202.0 | 03.5 | 262 | 262.0 | 04.6 |
| 23 | 23.0 | 00.4 | 83 | 83.0 | 01.4 | 143 | 143.0 | 02.5 | 203 | 203.0 | 03.5 | 263 | 263.0 | 04.6 |
| 24 | 24.0 | 00.4 | 84 | 84.0 | 01.5 | 144 | 144.0 | 02.5 | 204 | 204.0 | 03.6 | 264 | 264.0 | 04.6 |
| 25 | 25.0 | 00.4 | 85 | 85.0 | 01.5 | 145 | 145.0 | 02.5 | 205 | 205.0 | 03.6 | 265 | 265.0 | 04.6 |
| 26 | 26.0 | 00.5 | 86 | 86.0 | 01.5 | 146 | 146.0 | 02.5 | 206 | 206.0 | 03.6 | 266 | 266.0 | 04.6 |
| 27 | 27.0 | 00.5 | 87 | 87.0 | 01.5 | 147 | 147.0 | 02.6 | 207 | 207.0 | 03.6 | 267 | 267.0 | 04.7 |
| 28 | 28.0 | 00.5 | 88 | 88.0 | 01.5 | 148 | 148.0 | 02.6 | 208 | 208.0 | 03.6 | 268 | 268.0 | 04.7 |
| 29 | 29.0 | 00.5 | 89 | 89.0 | 01.6 | 149 | 149.0 | 02.6 | 209 | 209.0 | 03.7 | 269 | 269.0 | 04.7 |
| 30 | 30.0 | 00.5 | 90 | 90.0 | 01.6 | 150 | 150.0 | 02.6 | 210 | 210.0 | 03.7 | 270 | 270.0 | 04.7 |
| 31 | 31.0 | 00.5 | 91 | 91.0 | 01.6 | 151 | 151.0 | 02.6 | 211 | 211.0 | 03.7 | 271 | 271.0 | 04.7 |
| 32 | 32.0 | 00.6 | 92 | 92.0 | 01.6 | 152 | 152.0 | 02.7 | 212 | 212.0 | 03.7 | 272 | 272.0 | 04.7 |
| 33 | 33.0 | 00.6 | 93 | 93.0 | 01.6 | 153 | 153.0 | 02.7 | 213 | 213.0 | 03.7 | 273 | 273.0 | 04.8 |
| 34 | 34.0 | 00.6 | 94 | 94.0 | 01.6 | 154 | 154.0 | 02.7 | 214 | 214.0 | 03.7 | 274 | 274.0 | 04.8 |
| 35 | 35.0 | 00.6 | 95 | 95.0 | 01.7 | 155 | 155.0 | 02.7 | 215 | 215.0 | 03.8 | 275 | 275.0 | 04.8 |
| 36 | 36.0 | 00.6 | 96 | 96.0 | 01.7 | 156 | 156.0 | 02.7 | 216 | 216.0 | 03.8 | 276 | 276.0 | 04.8 |
| 37 | 37.0 | 00.6 | 97 | 97.0 | 01.7 | 157 | 157.0 | 02.7 | 217 | 217.0 | 03.8 | 277 | 277.0 | 04.8 |
| 38 | 38.0 | 00.7 | 98 | 98.0 | 01.7 | 158 | 158.0 | 02.8 | 218 | 218.0 | 03.8 | 278 | 278.0 | 04.9 |
| 39 | 39.0 | 00.7 | 99 | 99.0 | 01.7 | 159 | 159.0 | 02.8 | 219 | 219.0 | 03.8 | 279 | 279.0 | 04.9 |
| 40 | 40.0 | 00.7 | 100 | 100.0 | 01.7 | 160 | 160.0 | 02.8 | 220 | 220.0 | 03.8 | 280 | 280.0 | 04.9 |
| 41 | 41.0 | 00.7 | 101 | 101.0 | 01.8 | 161 | 161.0 | 02.8 | 221 | 221.0 | 03.9 | 281 | 281.0 | 04.9 |
| 42 | 42.0 | 00.7 | 102 | 102.0 | 01.8 | 162 | 162.0 | 02.8 | 222 | 222.0 | 03.9 | 282 | 282.0 | 04.9 |
| 43 | 43.0 | 00.8 | 103 | 103.0 | 01.8 | 163 | 163.0 | 02.8 | 223 | 223.0 | 03.9 | 283 | 283.0 | 04.9 |
| 44 | 44.0 | 00.8 | 104 | 104.0 | 01.8 | 164 | 164.0 | 02.9 | 224 | 224.0 | 03.9 | 284 | 284.0 | 05.0 |
| 45 | 45.0 | 00.8 | 105 | 105.0 | 01.8 | 165 | 165.0 | 02.9 | 225 | 225.0 | 03.9 | 285 | 285.0 | 05.0 |
| 46 | 46.0 | 00.8 | 106 | 106.0 | 01.8 | 166 | 166.0 | 02.9 | 226 | 226.0 | 03.9 | 286 | 286.0 | 05.0 |
| 47 | 47.0 | 00.8 | 107 | 107.0 | 01.9 | 167 | 167.0 | 02.9 | 227 | 227.0 | 04.0 | 287 | 287.0 | 05.0 |
| 48 | 48.0 | 00.8 | 108 | 108.0 | 01.9 | 168 | 168.0 | 02.9 | 228 | 228.0 | 04.0 | 288 | 288.0 | 05.0 |
| 49 | 49.0 | 00.9 | 109 | 109.0 | 01.9 | 169 | 169.0 | 02.9 | 229 | 229.0 | 04.0 | 289 | 289.0 | 05.0 |
| 50 | 50.0 | 00.9 | 110 | 110.0 | 01.9 | 170 | 170.0 | 03.0 | 230 | 230.0 | 04.0 | 290 | 290.0 | 05.1 |
| 51 | 51.0 | 00.9 | 111 | 111.0 | 01.9 | 171 | 171.0 | 03.0 | 231 | 231.0 | 04.0 | 291 | 291.0 | 05.1 |
| 52 | 52.0 | 00.9 | 112 | 112.0 | 02.0 | 172 | 172.0 | 03.0 | 232 | 232.0 | 04.0 | 292 | 292.0 | 05.1 |
| 53 | 53.0 | 00.9 | 113 | 113.0 | 02.0 | 173 | 173.0 | 03.0 | 233 | 233.0 | 04.1 | 293 | 293.0 | 05.1 |
| 54 | 54.0 | 00.9 | 114 | 114.0 | 02.0 | 174 | 174.0 | 03.0 | 234 | 234.0 | 04.1 | 294 | 294.0 | 05.1 |
| 55 | 55.0 | 01.0 | 115 | 115.0 | 02.0 | 175 | 175.0 | 03.1 | 235 | 235.0 | 04.1 | 295 | 295.0 | 05.1 |
| 56 | 56.0 | 01.0 | 116 | 116.0 | 02.0 | 176 | 176.0 | 03.1 | 236 | 236.0 | 04.1 | 296 | 296.0 | 05.2 |
| 57 | 57.0 | 01.0 | 117 | 117.0 | 02.0 | 177 | 177.0 | 03.1 | 237 | 237.0 | 04.1 | 297 | 297.0 | 05.2 |
| 58 | 58.0 | 01.0 | 118 | 118.0 | 02.1 | 178 | 178.0 | 03.1 | 238 | 238.0 | 04.2 | 298 | 298.0 | 05.2 |
| 59 | 59.0 | 01.0 | 119 | 119.0 | 02.1 | 179 | 179.0 | 03.1 | 239 | 239.0 | 04.2 | 299 | 299.0 | 05.2 |
| 60 | 60.0 | 01.0 | 120 | 120.0 | 02.1 | 180 | 180.0 | 03.1 | 240 | 240.0 | 04.2 | 300 | 300.0 | 05.2 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 2 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.0 | 61 | 61.0 | 02.1 | 121 | 120.9 | 04.2 | 181 | 180.9 | 06.3 | 241 | 240.9 | 08.4 |
| 2 | 02.0 | 00.1 | 62 | 62.0 | 02.2 | 122 | 121.9 | 04.3 | 182 | 181.9 | 06.4 | 242 | 241.9 | 08.4 |
| 3 | 03.0 | 00.1 | 63 | 63.0 | 02.2 | 123 | 122.9 | 04.3 | 183 | 182.9 | 06.4 | 243 | 242.9 | 08.5 |
| 4 | 04.0 | 00.1 | 64 | 64.0 | 02.2 | 124 | 123.9 | 04.3 | 184 | 183.9 | 06.4 | 244 | 243.9 | 08.5 |
| 5 | 05.0 | 00.2 | 65 | 65.0 | 02.3 | 125 | 124.9 | 04.4 | 185 | 184.9 | 06.5 | 245 | 244.9 | 08.6 |
| 6 | 06.0 | 00.2 | 66 | 66.0 | 02.3 | 126 | 125.9 | 04.4 | 186 | 185.9 | 06.5 | 246 | 245.8 | 08.6 |
| 7 | 07.0 | 00.2 | 67 | 67.0 | 02.3 | 127 | 126.9 | 04.4 | 187 | 186.9 | 06.5 | 247 | 246.8 | 08.6 |
| 8 | 08.0 | 00.3 | 68 | 68.0 | 02.4 | 128 | 127.9 | 04.5 | 188 | 187.9 | 06.6 | 248 | 247.8 | 08.7 |
| 9 | 09.0 | 00.3 | 69 | 69.0 | 02.4 | 129 | 128.9 | 04.5 | 189 | 188.9 | 06.6 | 249 | 248.8 | 08.7 |
| 10 | 10.0 | 00.3 | 70 | 70.0 | 02.4 | 130 | 129.9 | 04.5 | 190 | 189.9 | 06.6 | 250 | 249.8 | 08.7 |
| 11 | 11.0 | 00.4 | 71 | 71.0 | 02.5 | 131 | 130.9 | 04.6 | 191 | 190.9 | 06.7 | 251 | 250.8 | 08.8 |
| 12 | 12.0 | 00.4 | 72 | 72.0 | 02.5 | 132 | 131.9 | 04.6 | 192 | 191.9 | 06.7 | 252 | 251.8 | 08.8 |
| 13 | 13.0 | 00.5 | 73 | 73.0 | 02.5 | 133 | 132.9 | 04.6 | 193 | 192.9 | 06.7 | 253 | 252.8 | 08.8 |
| 14 | 14.0 | 00.5 | 74 | 74.0 | 02.6 | 134 | 133.9 | 04.7 | 194 | 193.9 | 06.8 | 254 | 253.8 | 08.9 |
| 15 | 15.0 | 00.5 | 75 | 75.0 | 02.6 | 135 | 134.9 | 04.7 | 195 | 194.9 | 06.8 | 255 | 254.8 | 08.9 |
| 16 | 16.0 | 00.6 | 76 | 76.0 | 02.7 | 136 | 135.9 | 04.7 | 196 | 195.9 | 06.8 | 256 | 255.8 | 08.9 |
| 17 | 17.0 | 00.6 | 77 | 77.0 | 02.7 | 137 | 136.9 | 04.8 | 197 | 196.9 | 06.9 | 257 | 256.8 | 09.0 |
| 18 | 18.0 | 00.6 | 78 | 78.0 | 02.7 | 138 | 137.9 | 04.8 | 198 | 197.9 | 06.9 | 258 | 257.8 | 09.0 |
| 19 | 19.0 | 00.7 | 79 | 79.0 | 02.8 | 139 | 138.9 | 04.9 | 199 | 198.9 | 06.9 | 259 | 258.8 | 09.0 |
| 20 | 20.0 | 00.7 | 80 | 80.0 | 02.8 | 140 | 139.9 | 04.9 | 200 | 199.9 | 07.0 | 260 | 259.8 | 09.1 |
| 21 | 21.0 | 00.7 | 81 | 81.0 | 02.8 | 141 | 140·9 | 04.9 | 201 | 200.9 | 07.0 | 261 | 260.8 | 09.1 |
| 22 | 22.0 | 00.8 | 82 | 81.9 | 02.9 | 142 | 141.9 | 05.0 | 202 | 201.9 | 07.0 | 262 | 261.8 | 09.1 |
| 23 | 23.0 | 00.8 | 83 | 82.9 | 02.9 | 143 | 142.9 | 05.0 | 203 | 202.9 | 07.1 | 263 | 262.8 | 09.2 |
| 24 | 24.0 | 00.8 | 84 | 83.9 | 02.9 | 144 | 143.9 | 05.0 | 204 | 203.9 | 07.1 | 264 | 263.8 | 09.2 |
| 25 | 25.0 | 00.9 | 85 | 84.9 | 03.0 | 145 | 144.9 | 05.1 | 205 | 204.9 | 07.2 | 265 | 264.8 | 09.2 |
| 26 | 26.0 | 00.9 | 86 | 85.9 | 03.0 | 146 | 145.9 | 05.1 | 206 | 205.9 | 07.2 | 266 | 265.8 | 09.3 |
| 27 | 27.0 | 00.9 | 87 | 86.9 | 03.0 | 147 | 146.9 | 05.1 | 207 | 206.9 | 07.2 | 267 | 266.8 | 09.3 |
| 28 | 28.0 | 01.0 | 88 | 87.9 | 03.1 | 148 | 147.9 | 05.2 | 208 | 207.9 | 07.3 | 268 | 267.8 | 09.4 |
| 29 | 29.0 | 01.0 | 89 | 88.9 | 03.1 | 149 | 148.9 | 05.2 | 209 | 208.9 | 07.3 | 269 | 268.8 | 09.4 |
| 30 | 30.0 | 01.0 | 90 | 89.9 | 03.1 | 150 | 149.9 | 05.2 | 210 | 209.9 | 07.3 | 270 | 269.8 | 09.4 |
| 31 | 31.0 | 01.1 | 91 | 90.9 | 03.2 | 151 | 150.9 | 05.3 | 211 | 210.9 | 07.4 | 271 | 270.8 | 09.5 |
| 32 | 32.0 | 01.1 | 92 | 91.9 | 03.2 | 152 | 151.9 | 05.3 | 212 | 211.9 | 07.4 | 272 | 271.8 | 09.5 |
| 33 | 33.0 | 01.2 | 93 | 92.9 | 03.2 | 153 | 152.9 | 05.3 | 213 | 212.9 | 07.4 | 273 | 272.8 | 09.5 |
| 34 | 34.0 | 01.2 | 94 | 93.9 | 03.3 | 154 | 153.9 | 05.4 | 214 | 213.9 | 07.5 | 274 | 273.8 | 09.6 |
| 35 | 35.0 | 01.2 | 95 | 94.9 | 03.3 | 155 | 154.9 | 05.4 | 215 | 214.9 | 07.5 | 275 | 274.8 | 09.6 |
| 36 | 36.0 | 01.3 | 96 | 95.9 | 03.4 | 156 | 155.9 | 05.4 | 216 | 215.9 | 07.5 | 276 | 275.8 | 09.6 |
| 37 | 37.0 | 01.3 | 97 | 96.9 | 03.4 | 157 | 156.9 | 05.5 | 217 | 216.9 | 07.6 | 277 | 276.8 | 09.7 |
| 38 | 38.0 | 01.3 | 98 | 97.9 | 03.4 | 158 | 157.9 | 05.5 | 218 | 217.9 | 07.6 | 278 | 277.8 | 09.7 |
| 39 | 39.0 | 01.4 | 99 | 98.9 | 03.5 | 159 | 158.9 | 05.5 | 219 | 218.9 | 07.6 | 279 | 278.8 | 09.7 |
| 40 | 40.0 | 01.4 | 100 | 99.9 | 03.5 | 160 | 159.9 | 05.6 | 220 | 219.9 | 07.7 | 280 | 279.8 | 09.8 |
| 41 | 41.0 | 01.4 | 101 | 100.9 | 03.5 | 161 | 160.9 | 05.6 | 221 | 220.9 | 07.7 | 281 | 280.8 | 09.8 |
| 42 | 42.0 | 01.5 | 102 | 101.9 | 03.6 | 162 | 161.9 | 05.7 | 222 | 221.9 | 07.7 | 282 | 281.8 | 09.8 |
| 43 | 43.0 | 01.5 | 103 | 102.9 | 03.6 | 163 | 162.9 | 05.7 | 223 | 222.9 | 07.8 | 283 | 282.8 | 09.9 |
| 44 | 44.0 | 01.5 | 104 | 103.9 | 03.6 | 164 | 163.9 | 05.7 | 224 | 223.9 | 07.8 | 284 | 283.8 | 09.9 |
| 45 | 45.0 | 01.6 | 105 | 104.9 | 03.7 | 165 | 164.9 | 05.8 | 225 | 224.9 | 07.9 | 285 | 284.8 | 09.9 |
| 46 | 46.0 | 01.6 | 106 | 105.9 | 03.7 | 166 | 165.9 | 05.8 | 226 | 225.9 | 07.9 | 286 | 285.8 | 10.0 |
| 47 | 47.0 | 01.6 | 107 | 106.9 | 03.7 | 167 | 166.9 | 05.8 | 227 | 226.9 | 07.9 | 287 | 286.8 | 10.0 |
| 48 | 48.0 | 01.7 | 108 | 107.9 | 03.8 | 168 | 167.9 | 05.9 | 228 | 227.9 | 08.0 | 288 | 287.8 | 10.1 |
| 49 | 49.0 | 01.7 | 109 | 108.9 | 03.8 | 169 | 168.9 | 05.9 | 229 | 228.9 | 08.0 | 289 | 288.8 | 10.1 |
| 50 | 50.0 | 01.7 | 110 | 109.9 | 03.8 | 170 | 169.9 | 05.9 | 230 | 229.9 | 08.0 | 290 | 289.8 | 10.1 |
| 51 | 51.0 | 01.8 | 111 | 110.9 | 03.9 | 171 | 170.9 | 06.0 | 231 | 230.9 | 08.1 | 291 | 290.8 | 10.2 |
| 52 | 52.0 | 01.8 | 112 | 111.9 | 03.9 | 172 | 171.9 | 06.0 | 232 | 231.9 | 08.1 | 292 | 291.8 | 10.2 |
| 53 | 53.0 | 01.8 | 113 | 112.9 | 03.9 | 173 | 172.9 | 06.0 | 233 | 232.9 | 08.1 | 293 | 292.8 | 10.2 |
| 54 | 54.0 | 01.9 | 114 | 113.9 | 04.0 | 174 | 173.9 | 06.1 | 234 | 233.9 | 08.2 | 294 | 293.8 | 10.3 |
| 55 | 55.0 | 01.9 | 115 | 114.9 | 04.0 | 175 | 174.9 | 06.1 | 235 | 234.9 | 08.2 | 295 | 294.8 | 10.3 |
| 56 | 56.0 | 02.0 | 116 | 115.9 | 04.0 | 176 | 175.9 | 06.1 | 236 | 235.9 | 08.2 | 296 | 295.8 | 10.3 |
| 57 | 57.0 | 02.0 | 117 | 116.9 | 04.1 | 177 | 176.9 | 06.2 | 237 | 236.9 | 08.3 | 297 | 296.8 | 10.4 |
| 58 | 58.0 | 02.0 | 118 | 117.9 | 04.1 | 178 | 177.9 | 06.2 | 238 | 237.9 | 08.3 | 298 | 297.8 | 10.4 |
| 59 | 59.0 | 02.1 | 119 | 118.9 | 04.2 | 179 | 178.9 | 06.2 | 239 | 238.9 | 08.3 | 299 | 298.8 | 10.4 |
| 60 | 60.0 | 02.1 | 120 | 119.9 | 04.2 | 180 | 179.9 | 06.3 | 240 | 239.9 | 08.4 | 300 | 299.8 | 10.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

## Difference of Latitude and Departure for 3 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.9 | 03.2 | 121 | 120.8 | 06.3 | 181 | 180.8 | 09.5 | 241 | 240.7 | 12.6 |
| 2 | 02.0 | 00.1 | 62 | 61.9 | 03.2 | 122 | 121.8 | 06.4 | 182 | 181.8 | 09.5 | 242 | 241.7 | 12.7 |
| 3 | 03.0 | 00.2 | 63 | 62.9 | 03.3 | 123 | 122.8 | 06.4 | 183 | 182.7 | 09.6 | 243 | 242.7 | 12.7 |
| 4 | 04.0 | 00.2 | 64 | 63.9 | 03.3 | 124 | 123.8 | 06.5 | 184 | 183.7 | 09.6 | 244 | 243.7 | 12.8 |
| 5 | 05.0 | 00.3 | 65 | 64.9 | 03.4 | 125 | 124.8 | 06.5 | 185 | 184.7 | 09.7 | 245 | 244.7 | 12.8 |
| 6 | 06.0 | 00.3 | 66 | 65.9 | 03.5 | 126 | 125.8 | 06.6 | 186 | 185.7 | 09.7 | 246 | 245.7 | 12.9 |
| 7 | 07.0 | 00.4 | 67 | 66.9 | 03.5 | 127 | 126.8 | 06.6 | 187 | 186.7 | 09.8 | 247 | 246.7 | 12.9 |
| 8 | 08.0 | 00.4 | 68 | 67.9 | 03.6 | 128 | 127.8 | 06.7 | 188 | 187.7 | 09.8 | 248 | 247.7 | 13.0 |
| 9 | 09.0 | 00.5 | 69 | 68.9 | 03.6 | 129 | 128.8 | 06.8 | 189 | 188.7 | 09.9 | 249 | 248.7 | 13.0 |
| 10 | 10.0 | 00.5 | 70 | 69.9 | 03.7 | 130 | 129.8 | 06.8 | 190 | 189.7 | 09.9 | 250 | 249.7 | 13.1 |
| 11 | 11.0 | 00.6 | 71 | 70.9 | 03.7 | 131 | 130.8 | 06.9 | 191 | 190.7 | 10.0 | 251 | 250.7 | 13.1 |
| 12 | 12.0 | 00.6 | 72 | 71.9 | 03.8 | 132 | 131.8 | 06.9 | 192 | 191.7 | 10.0 | 252 | 251.7 | 13.2 |
| 13 | 13.0 | 00.7 | 73 | 72.9 | 03.8 | 133 | 132.8 | 07.0 | 193 | 192.7 | 10.1 | 253 | 252.7 | 13.2 |
| 14 | 14.0 | 00.7 | 74 | 73.9 | 03.9 | 134 | 133.8 | 07.0 | 194 | 193.7 | 10.2 | 254 | 253.7 | 13.3 |
| 15 | 15.0 | 00.8 | 75 | 74.9 | 03.9 | 135 | 134.8 | 07.1 | 195 | 194.7 | 10.2 | 255 | 254.7 | 13.3 |
| 16 | 16.0 | 00.8 | 76 | 75.9 | 04.0 | 136 | 135.8 | 07.1 | 196 | 195.7 | 10.3 | 256 | 255.6 | 13.4 |
| 17 | 17.0 | 00.9 | 77 | 76.9 | 04.0 | 137 | 136.8 | 07.2 | 197 | 196.7 | 10.3 | 257 | 256.6 | 13.5 |
| 18 | 18.0 | 00.9 | 78 | 77.9 | 04.1 | 138 | 137.8 | 07.2 | 198 | 197.7 | 10.4 | 258 | 257.6 | 13.5 |
| 19 | 19.0 | 01.0 | 79 | 78.9 | 04.1 | 139 | 138.8 | 07.3 | 199 | 198.7 | 10.4 | 259 | 258.6 | 13.6 |
| 20 | 20.0 | 01.0 | 80 | 79.9 | 04.2 | 140 | 139.8 | 07.3 | 200 | 199.7 | 10.5 | 260 | 259.6 | 13.6 |
| 21 | 21.0 | 01.1 | 81 | 80.9 | 04.2 | 141 | 140·8 | 07.4 | 201 | 200.7 | 10.5 | 261 | 260.6 | 13.7 |
| 22 | 22.0 | 01.2 | 82 | 81.9 | 04.3 | 142 | 141.8 | 07.4 | 202 | 201.7 | 10.6 | 262 | 261.6 | 13.7 |
| 23 | 23.0 | 01.2 | 83 | 82.9 | 04.3 | 143 | 142.8 | 07.5 | 203 | 202.7 | 10.6 | 263 | 262.6 | 13.8 |
| 24 | 24.0 | 01.3 | 84 | 83.9 | 04.4 | 144 | 143.8 | 07.5 | 204 | 203.7 | 10.7 | 264 | 263.6 | 13.8 |
| 25 | 25.0 | 01.3 | 85 | 84.9 | 04.4 | 145 | 144.8 | 07.6 | 205 | 204.7 | 10.7 | 265 | 264.6 | 13.9 |
| 26 | 26.0 | 01.4 | 86 | 85.9 | 04.5 | 146 | 145.8 | 07.6 | 206 | 205.7 | 10.8 | 266 | 265.6 | 13.9 |
| 27 | 27.0 | 01.4 | 87 | 86.9 | 04.6 | 147 | 146.8 | 07.7 | 207 | 206.7 | 10.8 | 267 | 266.6 | 14.0 |
| 28 | 28.0 | 01.5 | 88 | 87.9 | 04.6 | 148 | 147.8 | 07.7 | 208 | 207.7 | 10.9 | 268 | 267.6 | 14.0 |
| 29 | 29.0 | 01.5 | 89 | 88.9 | 04.7 | 149 | 148.8 | 07.8 | 209 | 208.7 | 10.9 | 269 | 268.6 | 14.1 |
| 30 | 30.0 | 01.6 | 90 | 89.9 | 04.7 | 150 | 149.8 | 07.9 | 210 | 209.7 | 11.0 | 270 | 269.6 | 14.1 |
| 31 | 31.0 | 01.6 | 91 | 90.9 | 04.8 | 151 | 150.8 | 07.9 | 211 | 210.7 | 11.0 | 271 | 270.6 | 14.2 |
| 32 | 32.0 | 01.7 | 92 | 91.9 | 04.8 | 152 | 151.8 | 08.0 | 212 | 211.7 | 11.1 | 272 | 271.6 | 14.2 |
| 33 | 33.0 | 01.7 | 93 | 92.9 | 04.9 | 153 | 152.8 | 08.0 | 213 | 212.7 | 11.1 | 273 | 272.6 | 14.3 |
| 34 | 34.0 | 01.8 | 94 | 93.9 | 04.9 | 154 | 153.8 | 08.1 | 214 | 213.7 | 11.2 | 274 | 273.6 | 14.3 |
| 35 | 35.0 | 01.8 | 95 | 94.9 | 05.0 | 155 | 154.8 | 08.1 | 215 | 214.7 | 11.3 | 275 | 274.6 | 14.4 |
| 36 | 36.0 | 01.9 | 96 | 95.9 | 05.0 | 156 | 155.8 | 08.2 | 216 | 215.7 | 11.3 | 276 | 275.6 | 14.4 |
| 37 | 36.9 | 01.9 | 97 | 96.9 | 05.1 | 157 | 156.8 | 08.2 | 217 | 216.7 | 11.4 | 277 | 276.6 | 14.5 |
| 38 | 37.9 | 02.0 | 98 | 97.9 | 05.1 | 158 | 157.8 | 08.3 | 218 | 217.7 | 11.4 | 278 | 277.6 | 14.5 |
| 39 | 38.9 | 02.0 | 99 | 98.9 | 05.2 | 159 | 158.8 | 08.3 | 219 | 218.7 | 11.5 | 279 | 278.6 | 14.6 |
| 40 | 39.9 | 02.1 | 100 | 99.9 | 05.2 | 160 | 159.8 | 08.4 | 220 | 219.7 | 11.5 | 280 | 279.6 | 14.7 |
| 41 | 40.9 | 02.1 | 101 | 100.9 | 05.3 | 161 | 160.8 | 08.4 | 221 | 220.7 | 11.6 | 281 | 280.6 | 14.7 |
| 42 | 41.9 | 02.2 | 102 | 101.9 | 05.3 | 162 | 161.8 | 08.5 | 222 | 221.7 | 11.6 | 282 | 281.6 | 14.8 |
| 43 | 42.9 | 02.3 | 103 | 102.9 | 05.4 | 163 | 162.8 | 08.5 | 223 | 222.7 | 11.7 | 283 | 282.6 | 14.8 |
| 44 | 43.9 | 02.3 | 104 | 103.9 | 05.4 | 164 | 163.8 | 08.6 | 224 | 223.7 | 11.7 | 284 | 283.6 | 14.9 |
| 45 | 44.9 | 02.4 | 105 | 104.9 | 05.5 | 165 | 164.8 | 08.6 | 225 | 224.7 | 11.8 | 285 | 284.6 | 14.9 |
| 46 | 45.9 | 02.4 | 106 | 105.9 | 05.5 | 166 | 165.8 | 08.7 | 226 | 225.7 | 11.8 | 286 | 285.6 | 15.0 |
| 47 | 46.9 | 02.5 | 107 | 106.9 | 05.6 | 167 | 166.8 | 08.7 | 227 | 226.7 | 11.9 | 287 | 286.6 | 15.0 |
| 48 | 47.9 | 02.5 | 108 | 107.9 | 05.7 | 168 | 167.8 | 08.8 | 228 | 227.7 | 11.9 | 288 | 287.6 | 15.1 |
| 49 | 48.9 | 02.6 | 109 | 108.9 | 05.7 | 169 | 168.8 | 08.8 | 229 | 228.7 | 12.0 | 289 | 288.6 | 15.1 |
| 50 | 49.9 | 02.6 | 110 | 109.8 | 05.8 | 170 | 169.8 | 08.9 | 230 | 229.7 | 12.0 | 290 | 289.6 | 15.2 |
| 51 | 50.9 | 02.7 | 111 | 110.8 | 05.8 | 171 | 170.8 | 08.9 | 231 | 230.7 | 12.1 | 291 | 290.6 | 15.2 |
| 52 | 51.9 | 02.7 | 112 | 111.8 | 05.9 | 172 | 171.8 | 09.0 | 232 | 231.7 | 12.1 | 292 | 291.6 | 15.3 |
| 53 | 52.9 | 02.8 | 113 | 112.8 | 05.9 | 173 | 172.8 | 09.1 | 233 | 232.7 | 12.2 | 293 | 292.6 | 15.3 |
| 54 | 53.9 | 02.8 | 114 | 113.8 | 06.0 | 174 | 173.8 | 09.1 | 234 | 233.7 | 12.2 | 294 | 293.6 | 15.4 |
| 55 | 54.9 | 02.9 | 115 | 114.8 | 06.0 | 175 | 174.8 | 09.2 | 235 | 234.7 | 12.3 | 295 | 294.6 | 15.4 |
| 56 | 55.9 | 02.9 | 116 | 115.8 | 06.1 | 176 | 175.8 | 09.2 | 236 | 235.7 | 12.4 | 296 | 295.6 | 15.5 |
| 57 | 56.9 | 03.0 | 117 | 116.8 | 06.1 | 177 | 176.8 | 09.3 | 237 | 236.7 | 12.4 | 297 | 296.6 | 15.5 |
| 58 | 57.9 | 03.0 | 118 | 117.8 | 06.2 | 178 | 177.8 | 09.3 | 238 | 237.7 | 12.5 | 298 | 297.6 | 15.6 |
| 59 | 58.9 | 03.1 | 119 | 118.8 | 06.2 | 179 | 178.8 | 09.4 | 239 | 238.7 | 12.5 | 299 | 298.6 | 15.6 |
| 60 | 59.9 | 03.1 | 120 | 119.8 | 06.3 | 180 | 179.8 | 09.4 | 240 | 239.7 | 12.6 | 300 | 299.6 | 15.7 |
| ist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 4 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.9 | 04.3 | 121 | 120.7 | 08.4 | 181 | 180.6 | 12.6 | 241 | 240.4 | 16.8 |
| 2 | 02.0 | 00.1 | 62 | 61.8 | 04.3 | 122 | 121.7 | 08.5 | 182 | 181.6 | 12.7 | 242 | 241.4 | 16.9 |
| 3 | 03.0 | 00.2 | 63 | 62.8 | 04.4 | 123 | 122.7 | 08.6 | 183 | 182.6 | 12.8 | 243 | 242.4 | 17.0 |
| 4 | 04.0 | 00.3 | 64 | 63.8 | 04.5 | 124 | 123.7 | 08.6 | 184 | 183.6 | 12.8 | 244 | 243.4 | 17.0 |
| 5 | 05.0 | 00.3 | 65 | 64.8 | 04.5 | 125 | 124.7 | 08.7 | 185 | 184.5 | 12.9 | 245 | 244.4 | 17.1 |
| 6 | 06.0 | 00.4 | 66 | 65.8 | 04.6 | 126 | 125.7 | 08.8 | 186 | 185.5 | 13.0 | 246 | 245.4 | 17.2 |
| 7 | 07.0 | 00.5 | 67 | 66.8 | 04.7 | 127 | 126.7 | 08.9 | 187 | 186.5 | 13.0 | 247 | 246.4 | 17.2 |
| 8 | 08.0 | 00.6 | 68 | 67.8 | 04.7 | 128 | 127.7 | 08.9 | 188 | 187 5 | 13.1 | 248 | 247.4 | 17.3 |
| 9 | 09.0 | 00.6 | 69 | 68.8 | 04.8 | 129 | 128.7 | 09.0 | 189 | 188.5 | 13.2 | 249 | 248.4 | 17.4 |
| 10 | 10.0 | 00.7 | 70 | 69.8 | 04.9 | 130 | 129.7 | 09.1 | 190 | 189.5 | 13.3 | 250 | 249.4 | 17.4 |
| 11 | 11.0 | 00.8 | 71 | 70.8 | 05.0 | 131 | 130.7 | 09.1 | 191 | 190.5 | 13.3 | 251 | 250.4 | 17.5 |
| 12 | 12.0 | 00.8 | 72 | 71.8 | 05.0 | 132 | 131.7 | 09.2 | 192 | 191.5 | 13.4 | 252 | 251.4 | 17.6 |
| 13 | 13.0 | 00.9 | 73 | 72.8 | 05.1 | 133 | 132.7 | 09.3 | 193 | 192.5 | 13.5 | 253 | 252.4 | 17.6 |
| 14 | 14.0 | 01.0 | 74 | 73.8 | 05.2 | 134 | 133.7 | 09.3 | 194 | 193.5 | 13.5 | 254 | 253.4 | 17.7 |
| 15 | 15.0 | 01.0 | 75 | 74.8 | 05.2 | 135 | 134.7 | 09.4 | 195 | 194.5 | 13.6 | 255 | 254.4 | 17.8 |
| 16 | 16.0 | 01.1 | 76 | 75.8 | 05.3 | 136 | 135.7 | 09.5 | 196 | 195.5 | 13.7 | 256 | 255.4 | 17.9 |
| 17 | 17.0 | 01.2 | 77 | 76.8 | 05.4 | 137 | 136.7 | 09.6 | 197 | 196.5 | 13.7 | 257 | 256.4 | 17.9 |
| 18 | 18.0 | 01.3 | 78 | 77.8 | 05.4 | 138 | 137.7 | 09.6 | 198 | 197.5 | 13.8 | 258 | 257.4 | 18.0 |
| 19 | 19.0 | 01.3 | 79 | 78.8 | 05.5 | 139 | 138.7 | 09.7 | 199 | 198.5 | 13.9 | 259 | 258.4 | 18.1 |
| 20 | 20.0 | 01.4 | 80 | 79.8 | 05.6 | 140 | 139.7 | 09.8 | 200 | 199.5 | 14.0 | 260 | 259.4 | 18.1 |
| 21 | 20.9 | 01.5 | 81 | 80.8 | 05.7 | 141 | 140.7 | 09.8 | 201 | 200.5 | 14.0 | 261 | 260.4 | 18.2 |
| 22 | 21.9 | 01.5 | 82 | 81.8 | 05.7 | 142 | 141.7 | 09.9 | 202 | 201.5 | 14.1 | 262 | 261.4 | 18.3 |
| 23 | 22.9 | 01.6 | 83 | 82.8 | 05.8 | 143 | 142.7 | 10.0 | 203 | 202.5 | 14.2 | 263 | 262.4 | 18.3 |
| 24 | 23.9 | 01.7 | 84 | 83.8 | 05.9 | 144 | 143.6 | 10.0 | 204 | 203.5 | 14.2 | 264 | 263.4 | 18.4 |
| 25 | 24.9 | 01.7 | 85 | 84.8 | 05.9 | 145 | 144.6 | 10.1 | 205 | 204.5 | 14.3 | 265 | 264.4 | 18.5 |
| 26 | 25.9 | 01.8 | 86 | 85.8 | 06.0 | 146 | 145.6 | 10.2 | 206 | 205.5 | 14.4 | 266 | 265.4 | 18.6 |
| 27 | 26.9 | 01.9 | 87 | 86.8 | 06.1 | 147 | 146.6 | 10.3 | 207 | 206.5 | 14.4 | 267 | 266.3 | 18.6 |
| 28 | 27.9 | 02.0 | 88 | 87.8 | 06.1 | 148 | 147.6 | 10.3 | 208 | 207.5 | 14.5 | 268 | 267.3 | 18.7 |
| 29 | 28.9 | 02.0 | 89 | 88.8 | 06.2 | 149 | 148.6 | 10.4 | 209 | 208.5 | 14.6 | 269 | 268.3 | 18.8 |
| 30 | 29.9 | 02.1 | 90 | 89.8 | 06.3 | 150 | 149.6 | 10.5 | 210 | 209.5 | 14.6 | 270 | 269.3 | 18.8 |
| 31 | 30.9 | 02.2 | 91 | 90.8 | 06.3 | 151 | 150.6 | 10.5 | 211 | 210.5 | 14.7 | 271 | 270.3 | 18.9 |
| 32 | 31.9 | 02.2 | 92 | 91.8 | 06.4 | 152 | 151.6 | 10.6 | 212 | 211.5 | 14.8 | 272 | 271.3 | 19.0 |
| 33 | 32.9 | 02.3 | 93 | 92.8 | 06.5 | 153 | 152.6 | 10.7 | 213 | 212.5 | 14.9 | 273 | 272.3 | 19.0 |
| 34 | 33.9 | 02.4 | 94 | 93.8 | 06.6 | 154 | 153.6 | 10.7 | 214 | 213.5 | 14.9 | 274 | 273.3 | 19.1 |
| 35 | 34.9 | 02.4 | 95 | 94.8 | 06.6 | 155 | 154.6 | 10.8 | 215 | 214.5 | 15.0 | 275 | 274.3 | 19.2 |
| 36 | 35.9 | 02.5 | 96 | 95.8 | 06.7 | 156 | 155.6 | 10.9 | 216 | 215.5 | 15.1 | 276 | 275.3 | 19.3 |
| 37 | 36.9 | 02.6 | 97 | 96.8 | 06.8 | 157 | 156.6 | 11.0 | 217 | 216.5 | 15.1 | 277 | 276.3 | 19.3 |
| 38 | 37.9 | 02.7 | 98 | 97.8 | 06.8 | 158 | 157.6 | 11.0 | 218 | 217.5 | 15.2 | 278 | 277.3 | 19.4 |
| 39 | 38.9 | 02.7 | 99 | 98.8 | 06.9 | 159 | 158.6 | 11.1 | 219 | 218.5 | 15.3 | 279 | 278.3 | 19.5 |
| 40 | 39.9 | 02.8 | 100 | 99.8 | 07.0 | 160 | 159.6 | 11.2 | 220 | 219.5 | 15.3 | 280 | 279.3 | 19.5 |
| 41 | 40.9 | 02.9 | 101 | 100.8 | 07.0 | 161 | 160.6 | 11.2 | 221 | 220.5 | 15.4 | 281 | 280.3 | 19.6 |
| 42 | 41.9 | 02.9 | 102 | 101.8 | 07.1 | 162 | 161.6 | 11.3 | 222 | 221.5 | 15.5 | 282 | 281.3 | 19.7 |
| 43 | 42.9 | 03.0 | 103 | 102.7 | 07.2 | 163 | 162.6 | 11.4 | 223 | 222.5 | 15.6 | 283 | 282.3 | 19.7 |
| 44 | 43.9 | 03.1 | 104 | 103.7 | 07.3 | 164 | 163.6 | 11.4 | 224 | 223.5 | 15.6 | 284 | 283.3 | 19.8 |
| 45 | 44.9 | 03.1 | 105 | 104.7 | 07.3 | 165 | 164.6 | 11.5 | 225 | 224.5 | 15.7 | 285 | 284.3 | 19.9 |
| 46 | 45.9 | 03.2 | 106 | 105.7 | 07.4 | 166 | 165.6 | 11.6 | 226 | 225.4 | 15.8 | 286 | 285.3 | 20.0 |
| 47 | 46.9 | 03.3 | 107 | 106.7 | 07.5 | 167 | 166.6 | 11.6 | 227 | 226.4 | 15.8 | 287 | 286.3 | 20.0 |
| 48 | 47.9 | 03.3 | 108 | 107.7 | 07.5 | 168 | 167.6 | 11.7 | 228 | 227.4 | 15.9 | 288 | 287.3 | 20.1 |
| 49 | 48.9 | 03.4 | 109 | 108.7 | 07.6 | 169 | 168.6 | 11.8 | 229 | 228.4 | 16.0 | 289 | 288.3 | 20.2 |
| 50 | 49.9 | 03.5 | 110 | 109.7 | 07.7 | 170 | 169.6 | 11.9 | 230 | 229.4 | 16.0 | 290 | 289.3 | 20.2 |
| 51 | 50.9 | 03.6 | 111 | 110.7 | 07.7 | 171 | 170.6 | 11.9 | 231 | 230.4 | 16.1 | 291 | 290.3 | 20.3 |
| 52 | 51.9 | 03.6 | 112 | 111.7 | 07.8 | 172 | 171.6 | 12.0 | 232 | 231.4 | 16.2 | 292 | 291.3 | 20.4 |
| 53 | 52.9 | 03.7 | 113 | 112.7 | 07.9 | 173 | 172.6 | 12.1 | 233 | 232.4 | 16.3 | 293 | 292.3 | 20.4 |
| 54 | 53.9 | 03.8 | 114 | 113.7 | 08.0 | 174 | 173.6 | 12.1 | 234 | 233.4 | 16.3 | 294 | 293.3 | 20.5 |
| 55 | 54.9 | 03.8 | 115 | 114.7 | 08.0 | 175 | 174.6 | 12.2 | 235 | 234.4 | 16.4 | 295 | 294.3 | 20.6 |
| 56 | 55.9 | 03.9 | 116 | 115.7 | 08.1 | 176 | 175.6 | 12.3 | 236 | 235.4 | 16.5 | 296 | 295.3 | 20.6 |
| 57 | 56.9 | 04.0 | 117 | 116.7 | 08.2 | 177 | 176.6 | 12.3 | 237 | 236.4 | 16.5 | 297 | 296.3 | 20.7 |
| 58 | 57.9 | 04.0 | 118 | 117.7 | 08.2 | 178 | 177.6 | 12.4 | 238 | 237.4 | 16.6 | 298 | 297.3 | 20.8 |
| 59 | 58.9 | 04.1 | 119 | 118.7 | 08.3 | 179 | 178.6 | 12.5 | 239 | 238.4 | 16.7 | 299 | 298.3 | 20.9 |
| 60 | 59.9 | 04·2 | 120 | 119.7 | 08.4 | 180 | 179.6 | 12.6 | 240 | 239.4 | 16.7 | 300 | 299.3 | 20.9 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

Difference of Latitude and Departure for 5 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.8 | 05.3 | 121 | 120.5 | 10.5 | 181 | 180.3 | 15.8 | 241 | 240.1 | 21.0 |
| 2 | 02.0 | 00.2 | 62 | 61.8 | 05.4 | 122 | 121.5 | 10.6 | 182 | 181.3 | 15.9 | 242 | 241.1 | 21.1 |
| 3 | 03.0 | 00.3 | 63 | 62.8 | 05.5 | 123 | 122.5 | 10.7 | 183 | 182.3 | 15.9 | 243 | 242.1 | 21.2 |
| 4 | 04.0 | 00.3 | 64 | 63.8 | 05.6 | 124 | 123.5 | 10.8 | 184 | 183.3 | 16.0 | 244 | 243.1 | 21.3 |
| 5 | 05.0 | 00.4 | 65 | 64.8 | 05.7 | 125 | 124.5 | 10.9 | 185 | 184.3 | 16.1 | 245 | 244.1 | 21.4 |
| 6 | 06.0 | 00.5 | 66 | 65.7 | 05.8 | 126 | 125.5 | 11.0 | 186 | 185.3 | 16.2 | 246 | 245.1 | 21.4 |
| 7 | 07.0 | 00.6 | 67 | 66.7 | 05.8 | 127 | 126.5 | 11.1 | 187 | 186.3 | 16.3 | 247 | 246.1 | 21.5 |
| 8 | 08.0 | 00.7 | 68 | 67.7 | 05.9 | 128 | 127.5 | 11.2 | 188 | 187.3 | 16.4 | 248 | 247.1 | 21.6 |
| 9 | 09.0 | 00.8 | 69 | 68.7 | 06.0 | 129 | 128.5 | 11.2 | 189 | 188.3 | 16.5 | 249 | 248.1 | 21.7 |
| 10 | 10.0 | 00.9 | 70 | 69.7 | 06.1 | 130 | 129.5 | 11.3 | 190 | 189.3 | 16.6 | 250 | 249.0 | 21.7 |
| 11 | 11.0 | 01.0 | 71 | 70.7 | 06.2 | 131 | 130.5 | 11.4 | 191 | 190.3 | 16.6 | 251 | 250.0 | 21.9 |
| 12 | 12.0 | 01.0 | 72 | 71.7 | 06.3 | 132 | 131.5 | 11.5 | 192 | 191.3 | 16.7 | 252 | 251.0 | 22.0 |
| 13 | 13.0 | 01.1 | 73 | 72.7 | 06.4 | 133 | 132.5 | 11.6 | 193 | 192.3 | 16.8 | 253 | 252.0 | 22.1 |
| 14 | 13.9 | 01.2 | 74 | 73.7 | 06.4 | 134 | 133.5 | 11.7 | 194 | 193.3 | 16.9 | 254 | 253.0 | 22.1 |
| 15 | 14.9 | 01.3 | 75 | 74.7 | 06.5 | 135 | 134.5 | 11.8 | 195 | 194.3 | 17.0 | 255 | 254.0 | 22.2 |
| 16 | 15.9 | 01.4 | 76 | 75.7 | 06.6 | 136 | 135.5 | 11.9 | 196 | 195.3 | 17.1 | 256 | 255.0 | 22.3 |
| 17 | 16.9 | 01.5 | 77 | 76.7 | 06.7 | 137 | 136.5 | 11.9 | 197 | 196.3 | 17.2 | 257 | 256.0 | 22.4 |
| 18 | 17.9 | 01.6 | 78 | 77.7 | 06.8 | 138 | 137.5 | 12.0 | 198 | 197.2 | 17.3 | 258 | 257.0 | 22.5 |
| 19 | 18.9 | 01.7 | 79 | 78.7 | 06.9 | 139 | 138.5 | 12.1 | 199 | 198.2 | 17.3 | 259 | 258.0 | 22.6 |
| 20 | 19.9 | 01.7 | 80 | 79.7 | 07.0 | 140 | 139.5 | 12.2 | 200 | 199.2 | 17.4 | 260 | 259.0 | 22.7 |
| 21 | 20.9 | 01.8 | 81 | 80.7 | 07.1 | 141 | 140.5 | 12.3 | 201 | 200.2 | 17.5 | 261 | 260.0 | 22.7 |
| 22 | 21.9 | 01.9 | 82 | 81.7 | 07.1 | 142 | 141.5 | 12.4 | 202 | 201.2 | 17.6 | 262 | 261.0 | 22.8 |
| 23 | 22.9 | 02.0 | 83 | 82.7 | 07.2 | 143 | 142.5 | 12.5 | 203 | 202.2 | 17.7 | 263 | 262.0 | 22.9 |
| 24 | 23.9 | 02.1 | 84 | 83.7 | 07.3 | 144 | 143.5 | 12.6 | 204 | 203.2 | 17.8 | 264 | 263.0 | 23.0 |
| 25 | 24.9 | 02.2 | 85 | 84.7 | 07.4 | 145 | 144.4 | 12.6 | 205 | 204.2 | 17.9 | 265 | 264.0 | 23.1 |
| 26 | 25.9 | 02.3 | 86 | 85.7 | 07.5 | 146 | 145.4 | 12.7 | 206 | 205.2 | 18.0 | 266 | 265.0 | 23.2 |
| 27 | 26.9 | 02.4 | 87 | 86.7 | 07.6 | 147 | 146.4 | 12.8 | 207 | 206.2 | 18.0 | 267 | 266.0 | 23.3 |
| 28 | 27.9 | 02.4 | 88 | 87.7 | 07.7 | 148 | 147.4 | 12.9 | 208 | 207.2 | 18.1 | 268 | 267.0 | 23.4 |
| 29 | 28.9 | 02.5 | 89 | 88.7 | 07.8 | 149 | 148.4 | 13.0 | 209 | 208.2 | 18.2 | 269 | 268.0 | 23.4 |
| 30 | 29.9 | 02.6 | 90 | 89.7 | 07.8 | 150 | 149.4 | 13.1 | 210 | 209.2 | 18.3 | 270 | 269.0 | 23.5 |
| 31 | 30.9 | 02.7 | 91 | 90.7 | 07.9 | 151 | 150.4 | 13.2 | 211 | 210.2 | 18.4 | 271 | 270.0 | 23.6 |
| 32 | 31.9 | 02.8 | 92 | 91.6 | 08.0 | 152 | 151.4 | 13.2 | 212 | 211.2 | 18.5 | 272 | 271.0 | 23.7 |
| 33 | 32.9 | 02.9 | 93 | 92.6 | 08.1 | 153 | 152.4 | 13.3 | 213 | 212.2 | 18.6 | 273 | 272.0 | 23.8 |
| 34 | 33.9 | 03.0 | 94 | 93.6 | 08.2 | 154 | 153.4 | 13.4 | 214 | 213.2 | 18.7 | 274 | 273.0 | 23.9 |
| 35 | 34.9 | 03.1 | 95 | 94.6 | 08.3 | 155 | 154.4 | 13.5 | 215 | 214.2 | 18.7 | 275 | 274.0 | 24.0 |
| 36 | 35.9 | 03.1 | 96 | 95.6 | 08.4 | 156 | 155.4 | 13.6 | 216 | 215.2 | 18.8 | 276 | 274.9 | 24.1 |
| 37 | 36.9 | 03.2 | 97 | 96.6 | 08.5 | 157 | 156.4 | 13.7 | 217 | 216.2 | 18.9 | 277 | 275.9 | 24.1 |
| 38 | 37.9 | 03.3 | 98 | 97.6 | 08 5 | 158 | 157.4 | 13.8 | 218 | 217.2 | 19.0 | 278 | 276.9 | 24.2 |
| 39 | 38.9 | 03.4 | 99 | 98.6 | 08.6 | 159 | 158.4 | 13.9 | 219 | 218.2 | 19.1 | 279 | 277.9 | 24.3 |
| 40 | 39.8 | 03.5 | 100 | 99.6 | 08.7 | 160 | 159.4 | 13.9 | 220 | 219.2 | 19.2 | 280 | 278.9 | 24.4 |
| 41 | 40.8 | 03.6 | 101 | 100.6 | 08.8 | 161 | 160.4 | 14.0 | 221 | 220.2 | 19.3 | 281 | 279.9 | 24.5 |
| 42 | 41.8 | 03.7 | 102 | 101.6 | 08.9 | 162 | 161.4 | 14.1 | 222 | 221.2 | 19.3 | 282 | 280.9 | 24.6 |
| 43 | 42.8 | 03.7 | 103 | 102.6 | 09.0 | 163 | 162.4 | 14.2 | 223 | 222.2 | 19.4 | 283 | 281.9 | 24.7 |
| 44 | 43.8 | 03.8 | 104 | 103.6 | 09.1 | 164 | 163.4 | 14.3 | 224 | 223.1 | 19.5 | 284 | 282.9 | 24.8 |
| 45 | 44.8 | 03.9 | 105 | 104.6 | 09.2 | 165 | 164.4 | 14.4 | 225 | 224.1 | 19.6 | 285 | 283.9 | 24.8 |
| 46 | 45.8 | 04.0 | 106 | 105.6 | 09.2 | 166 | 165.4 | 14.5 | 226 | 225.1 | 19.7 | 286 | 284.9 | 24.9 |
| 47 | 46.8 | 04.1 | 107 | 106.6 | 09.3 | 167 | 166.4 | 14.6 | 227 | 226.1 | 19.8 | 287 | 285.9 | 25.0 |
| 48 | 47.8 | 04.2 | 108 | 107.6 | 09.4 | 168 | 167.4 | 14.6 | 228 | 227.1 | 19.9 | 288 | 286.9 | 25.1 |
| 49 | 48.8 | 04.3 | 109 | 108.6 | 09.5 | 169 | 168.4 | 14.7 | 229 | 228.1 | 20.0 | 289 | 287.9 | 25.2 |
| 50 | 49.8 | 04.4 | 110 | 109.6 | 09.6 | 170 | 169.4 | 14.8 | 230 | 229.1 | 20.0 | 290 | 288.9 | 25.3 |
| 51 | 50.8 | 04.4 | 111 | 110.6 | 09.7 | 171 | 170.3 | 14.9 | 231 | 230.1 | 20.1 | 291 | 289.9 | 25.4 |
| 52 | 51.8 | 04.5 | 112 | 111.6 | 09.8 | 172 | 171.3 | 15.0 | 232 | 231.1 | 20.2 | 292 | 290.9 | 25.4 |
| 53 | 52.8 | 04.6 | 113 | 112.6 | 09.8 | 173 | 172.3 | 15.1 | 233 | 232.1 | 20.3 | 293 | 291.9 | 25.5 |
| 54 | 53.8 | 04.7 | 114 | 113.6 | 09.9 | 174 | 173.3 | 15.2 | 234 | 233.1 | 20.4 | 294 | 292.9 | 25.6 |
| 55 | 54.8 | 04.8 | 115 | 114.6 | 10.0 | 175 | 174.3 | 15.3 | 235 | 234.1 | 20.5 | 295 | 293.9 | 25.7 |
| 56 | 55.8 | 04.9 | 116 | 115.6 | 10.1 | 176 | 175.3 | 15.3 | 236 | 235.1 | 20.6 | 296 | 294.9 | 25.8 |
| 57 | 56.8 | 05.0 | 117 | 116.6 | 10.2 | 177 | 176.3 | 15.4 | 237 | 236.1 | 20.7 | 297 | 295.9 | 25.9 |
| 58 | 57.8 | 05.1 | 118 | 117.6 | 10.3 | 178 | 177.3 | 15.5 | 238 | 237.1 | 20.7 | 298 | 296.9 | 26.0 |
| 59 | 58.8 | 05.1 | 119 | 118.5 | 10.4 | 179 | 178.3 | 15.6 | 239 | 238.1 | 20.8 | 299 | 297.9 | 26.1 |
| 60 | 59.8 | 05.2 | 120 | 119.5 | 10.5 | 180 | 179.3 | 15.7 | 240 | 239.1 | 20.9 | 300 | 298.9 | 26.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 6 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.7 | 06.4 | 121 | 120.3 | 12.6 | 181 | 180.0 | 18.9 | 241 | 239.7 | 25.2 |
| 2 | 02.0 | 00.2 | 62 | 61.7 | 06.5 | 122 | 121.3 | 12.8 | 182 | 181.0 | 19.0 | 242 | 240.7 | 25.3 |
| 3 | 03.0 | 00.3 | 63 | 62.7 | 06.6 | 123 | 122.3 | 12.9 | 183 | 182.0 | 19.1 | 243 | 241.7 | 25.4 |
| 4 | 04.0 | 00.4 | 64 | 63.6 | 06.7 | 124 | 123.3 | 13.0 | 184 | 183.0 | 19.2 | 244 | 242.7 | 25.5 |
| 5 | 05.0 | 00.5 | 65 | 64.6 | 06.8 | 125 | 124.3 | 13.1 | 185 | 184.0 | 19.3 | 245 | 243.7 | 25.6 |
| 6 | 06.0 | 00.6 | 66 | 65.6 | 06.9 | 126 | 125.3 | 13.2 | 186 | 185.0 | 19.4 | 246 | 244.7 | 25.7 |
| 7 | 07.0 | 00.7 | 67 | 66.6 | 07.0 | 127 | 126.3 | 13.3 | 187 | 186.0 | 19.5 | 247 | 245.6 | 25.8 |
| 8 | 08.0 | 00.8 | 68 | 67.6 | 07.1 | 128 | 127.3 | 13.4 | 188 | 187.0 | 19.7 | 248 | 246.6 | 25.9 |
| 9 | 09.0 | 00.9 | 69 | 68.6 | 07.2 | 129 | 128.3 | 13.5 | 189 | 188.0 | 19.8 | 249 | 247.6 | 26.0 |
| 10 | 09.9 | 01.0 | 70 | 69.6 | 07.3 | 130 | 129.3 | 13.6 | 190 | 189.0 | 19.9 | 250 | 248.6 | 26.1 |
| 11 | 10.9 | 01.1 | 71 | 70.6 | 07.4 | 131 | 130.3 | 13.7 | 191 | 190.0 | 20.0 | 251 | 249.6 | 26.2 |
| 12 | 11.9 | 01.3 | 72 | 71.6 | 07.5 | 132 | 131.3 | 13.8 | 192 | 190.9 | 20.1 | 252 | 250.6 | 26.3 |
| 13 | 12.9 | 01.4 | 73 | 72.6 | 07.6 | 133 | 132.3 | 13.9 | 193 | 191.9 | 20.2 | 253 | 251.6 | 26.4 |
| 14 | 13.9 | 01.5 | 74 | 73.6 | 07.7 | 134 | 133.3 | 14.0 | 194 | 192.9 | 20.3 | 254 | 252.6 | 26.6 |
| 15 | 14.9 | 01.6 | 75 | 74.6 | 07.8 | 135 | 134.3 | 14.1 | 195 | 193.9 | 20.4 | 255 | 253.6 | 26.7 |
| 16 | 15.9 | 01.7 | 76 | 75.6 | 07.9 | 136 | 135.3 | 14.2 | 196 | 194.9 | 20.5 | 256 | 254.6 | 26.8 |
| 17 | 16.9 | 01.8 | 77 | 76.6 | 08.0 | 137 | 136.2 | 14.3 | 197 | 195.9 | 20.6 | 257 | 255.6 | 26.9 |
| 18 | 17.9 | 01.9 | 78 | 77.6 | 08.2 | 138 | 137.2 | 14.4 | 198 | 196.9 | 20.7 | 258 | 256.6 | 27.0 |
| 19 | 18.9 | 02.0 | 79 | 78.6 | 08.3 | 139 | 138.2 | 14.5 | 199 | 197.9 | 20.8 | 259 | 257.6 | 27.1 |
| 20 | 19.9 | 02.1 | 80 | 79.6 | 08.4 | 140 | 139.2 | 14.6 | 200 | 198.9 | 20.9 | 260 | 258.6 | 27.2 |
| 21 | 20.9 | 02.2 | 81 | 80.6 | 08.5 | 141 | 140·2 | 14.7 | 201 | 199.9 | 21.0 | 261 | 259.6 | 27.3 |
| 22 | 21.9 | 02.3 | 82 | 81.6 | 08.6 | 142 | 141.2 | 14.8 | 202 | 200.9 | 21.1 | 262 | 260.6 | 27.4 |
| 23 | 22.9 | 02.4 | 83 | 82.5 | 08.7 | 143 | 142.2 | 14.9 | 203 | 201.9 | 21.2 | 263 | 261.6 | 27.5 |
| 24 | 23.9 | 02.5 | 84 | 83.5 | 08.8 | 144 | 143.2 | 15.1 | 204 | 202.9 | 21.3 | 264 | 262.6 | 27.6 |
| 25 | 24.9 | 02.6 | 85 | 84.5 | 08.9 | 145 | 144.2 | 15.2 | 205 | 203.9 | 21.4 | 265 | 263.5 | 27.7 |
| 26 | 25.9 | 02.7 | 86 | 85.5 | 09.0 | 146 | 145.2 | 15.3 | 206 | 204.9 | 21.5 | 266 | 264.5 | 27.8 |
| 27 | 26.9 | 02,8 | 87 | 86.5 | 09.1 | 147 | 146.2 | 15.4 | 207 | 205.9 | 21.6 | 267 | 265.5 | 27 9 |
| 28 | 27.8 | 02.9 | 88 | 87.5 | 09.2 | 148 | 147.2 | 15.5 | 208 | 206.9 | 21.7 | 268 | 266.5 | 28.0 |
| 29 | 28.8 | 03.0 | 89 | 88.5 | 09.3 | 149 | 148.2 | 15.6 | 209 | 207.9 | 21.8 | 269 | 267.5 | 28.1 |
| 30 | 29.8 | 03.1 | 90 | 89.5 | 09.4 | 150 | 149.2 | 15.7 | 210 | 208.8 | 22.0 | 270 | 268.5 | 28.2 |
| 31 | 30.8 | 03.2 | 91 | 90.5 | 09.5 | 151 | 150.2 | 15.8 | 211 | 209.8 | 22.1 | 271 | 269.5 | 28.3 |
| 32 | 31.8 | 03.3 | 92 | 91.5 | 09.6 | 152 | 151.2 | 15.9 | 212 | 210.8 | 22.2 | 272 | 270.5 | 28.4 |
| 33 | 32.8 | 03.4 | 93 | 92.5 | 09.7 | 153 | 152.2 | 16.0 | 213 | 211.8 | 22.3 | 273 | 271.5 | 28.5 |
| 34 | 33.8 | 03.6 | 94 | 93.5 | 09.8 | 154 | 153.2 | 16.1 | 214 | 212.8 | 22.4 | 274 | 272.5 | 28.6 |
| 35 | 34.8 | 03.7 | 95 | 94.5 | 09.9 | 155 | 154.2 | 16.2 | 215 | 213.8 | 22.5 | 275 | 273.5 | 28.7 |
| 36 | 35.8 | 03.8 | 96 | 95.5 | 10.0 | 156 | 155.1 | 16.3 | 216 | 214.8 | 22.6 | 276 | 274.5 | 28.8 |
| 37 | 36.8 | 03.9 | 97 | 96.5 | 10.1 | 157 | 156.1 | 16.4 | 217 | 215.8 | 22.7 | 277 | 275.5 | 29.0 |
| 38 | 37.8 | 04.0 | 98 | 97.5 | 10.2 | 158 | 157.1 | 16.5 | 218 | 216.8 | 22.8 | 278 | 276.5 | 29.1 |
| 39 | 38.8 | 04.1 | 99 | 98.5 | 10.3 | 159 | 158.1 | 16.6 | 219 | 217.8 | 22.9 | 279 | 277.5 | 29.2 |
| 40 | 39.8 | 04.2 | 100 | 99.5 | 10.5 | 160 | 159.1 | 16.7 | 220 | 218.8 | 23.0 | 280 | 278.5 | 29.3 |
| 41 | 40.8 | 04.3 | 101 | 100.4 | 10.6 | 161 | 160.1 | 16.8 | 221 | 219.8 | 23.1 | 281 | 279.5 | 29.4 |
| 42 | 41.8 | 04.4 | 102 | 101.4 | 10.7 | 162 | 161.1 | 16.9 | 222 | 220.8 | 23.2 | 282 | 280.5 | 29.5 |
| 43 | 42.8 | 04.5 | 103 | 102.4 | 10.8 | 163 | 162.1 | 17.0 | 223 | 221.8 | 23.3 | 283 | 281.4 | 29.6 |
| 44 | 43.8 | 04.6 | 104 | 103.4 | 10.9 | 164 | 163.1 | 17.1 | 224 | 222.8 | 23.4 | 284 | 282.4 | 29.7 |
| 45 | 44.8 | 04.7 | 105 | 104.4 | 11.0 | 165 | 164.1 | 17.2 | 225 | 223.8 | 23.5 | 285 | 283.4 | 29.8 |
| 46 | 45.7 | 04.8 | 106 | 105.4 | 11.1 | 166 | 165.1 | 17.4 | 226 | 224.8 | 23.6 | 286 | 284.4 | 29.9 |
| 47 | 46.7 | 04.9 | 107 | 106.4 | 11.2 | 167 | 166.1 | 17.5 | 227 | 225.8 | 23.7 | 287 | 285.4 | 30.0 |
| 48 | 47.7 | 05.0 | 108 | 107.4 | 11.3 | 168 | 167.1 | 17.6 | 228 | 226.8 | 23.8 | 288 | 286.4 | 30.1 |
| 49 | 48.7 | 05.1 | 109 | 108.4 | 11.4 | 169 | 168.1 | 17.7 | 229 | 227.7 | 23.9 | 289 | 287.4 | 30.2 |
| 50 | 49.7 | 05.2 | 110 | 109.4 | 11.5 | 170 | 169.1 | 17.8 | 230 | 228.7 | 24.0 | 290 | 288.4 | 30.3 |
| 51 | 50.7 | 05.3 | 111 | 110.4 | 11.6 | 171 | 170.1 | 17.9 | 231 | 229.7 | 24.1 | 291 | 289.4 | 30.4 |
| 52 | 51.7 | 05.4 | 112 | 111.4 | 11.7 | 172 | 171.1 | 18.0 | 232 | 230.7 | 24.3 | 292 | 290.4 | 30.5 |
| 53 | 52.7 | 05.5 | 113 | 112.4 | 11.8 | 173 | 172.1 | 18.1 | 233 | 231.7 | 24.4 | 293 | 291.4 | 30.6 |
| 54 | 53.7 | 05.6 | 114 | 113.4 | 11.9 | 174 | 173.0 | 18.2 | 234 | 232.7 | 24.5 | 294 | 292.4 | 30.7 |
| 55 | 54.7 | 05.7 | 115 | 114.4 | 12.0 | 175 | 174.0 | 18.3 | 235 | 233.7 | 24.6 | 295 | 293.4 | 30 8 |
| 56 | 55.7 | 05.9 | 116 | 115.4 | 12.1 | 176 | 175.0 | 18.4 | 236 | 234.7 | 24.7 | 296 | 294.4 | 30.9 |
| 57 | 56.7 | 06.0 | 117 | 116.4 | 12.2 | 177 | 176.0 | 18.5 | 237 | 235.7 | 24.8 | 297 | 295.4 | 31.0 |
| 58 | 57.7 | 06.1 | 118 | 117.4 | 12.3 | 178 | 177.0 | 18.6 | 238 | 236.7 | 24.9 | 298 | 296.4 | 31.1 |
| 59 | 58.7 | 06.2 | 119 | 118.3 | 12.4 | 179 | 178.0 | 18.7 | 239 | 237.7 | 25.0 | 299 | 297.4 | 31.3 |
| 60 | 59.7 | 06.3 | 120 | 119.3 | 12.5 | 180 | 179.0 | 18.8 | 240 | 238.7 | 25.1 | 300 | 298.4 | 31.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 7 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.5 | 07.4 | 121 | 120.1 | 14.7 | 181 | 179.7 | 22.1 | 241 | 239.2 | 29.4 |
| 2 | 02.0 | 00.2 | 62 | 61.5 | 07.6 | 122 | 121.1 | 14.9 | 182 | 180.6 | 22.2 | 242 | 240.2 | 29.5 |
| 3 | 03.0 | 00.4 | 63 | 62.5 | 07.7 | 123 | 122.1 | 15.0 | 183 | 181.6 | 22.3 | 243 | 241.2 | 29.6 |
| 4 | 04.0 | 00.5 | 64 | 63.5 | 07.8 | 124 | 123.1 | 15.1 | 184 | 182.6 | 22.4 | 244 | 242.2 | 29.7 |
| 5 | 05.0 | 00.6 | 65 | 64.5 | 07.9 | 125 | 124.1 | 15.2 | 185 | 183.6 | 22.5 | 245 | 243.2 | 29.9 |
| 6 | 06.0 | 00.7 | 66 | 65.5 | 08.0 | 126 | 125.1 | 15.4 | 186 | 184.6 | 22.7 | 246 | 244.2 | 30.0 |
| 7 | 06.9 | 00.9 | 67 | 66.5 | 08.2 | 127 | 126.1 | 15.5 | 187 | 185.6 | 22.8 | 247 | 245.2 | 30.1 |
| 8 | 07.9 | 01.0 | 68 | 67.5 | 08.3 | 128 | 127.0 | 15.6 | 188 | 186.6 | 22.9 | 248 | 246.2 | 30.2 |
| 9 | 08.9 | 01.1 | 69 | 68.5 | 08.4 | 129 | 128.0 | 15.7 | 189 | 187.6 | 23.0 | 249 | 247.1 | 30.3 |
| 10 | 09.9 | 01.2 | 70 | 69.5 | 08.5 | 130 | 129.0 | 15.8 | 190 | 188.6 | 23.2 | 250 | 248.1 | 30.5 |
| 11 | 10.9 | 01.3 | 71 | 70.5 | 08.7 | 131 | 130.0 | 16.0 | 191 | 189.6 | 23.3 | 251 | 249.1 | 30.6 |
| 12 | 11.9 | 01.5 | 72 | 71.5 | 08.8 | 132 | 131.0 | 16.1 | 192 | 190.6 | 23.4 | 252 | 250.1 | 30.7 |
| 13 | 12.9 | 01.6 | 73 | 72.5 | 08.9 | 133 | 132.0 | 16.2 | 193 | 191.6 | 23.5 | 253 | 251.1 | 30.8 |
| 14 | 13.9 | 01.7 | 74 | 73.4 | 09.0 | 134 | 133.0 | 16.3 | 194 | 192.6 | 23.6 | 254 | 252.1 | 31.0 |
| 15 | 14.9 | 01.8 | 75 | 74.4 | 09.1 | 135 | 134.0 | 16.5 | 195 | 193.5 | 23.8 | 255 | 253.1 | 31.1 |
| 16 | 15.9 | 01.9 | 76 | 75.4 | 09.3 | 136 | 135.0 | 16.6 | 196 | 194.5 | 23.9 | 256 | 254.1 | 31.2 |
| 17 | 16.9 | 02.1 | 77 | 76.4 | 09.4 | 137 | 136.0 | 16.7 | 197 | 195.5 | 24.0 | 257 | 255.1 | 31.3 |
| 18 | 17.9 | 02.2 | 78 | 77.4 | 09.5 | 138 | 137.0 | 16.8 | 198 | 196.5 | 24.1 | 258 | 256.1 | 31.4 |
| 19 | 18.9 | 02.3 | 79 | 78.4 | 09.6 | 139 | 138.0 | 16.9 | 199 | 197.5 | 24.3 | 259 | 257.1 | 31.6 |
| 20 | 19.9 | 02.4 | 80 | 79.4 | 09.7 | 140 | 139.0 | 17.1 | 200 | 198.5 | 24.4 | 260 | 258.1 | 31.7 |
| 21 | 20.8 | 02.6 | 81 | 80.4 | 09.9 | 141 | 139.9 | 17.2 | 201 | 199.5 | 24.5 | 261 | 259.1 | 31.8 |
| 22 | 21.8 | 02.7 | 82 | 81.4 | 10.0 | 142 | 140.9 | 17.3 | 202 | 200.5 | 24.6 | 262 | 260.0 | 31.9 |
| 23 | 22.8 | 02.8 | 83 | 82.4 | 10.1 | 143 | 141.9 | 17.4 | 203 | 201.5 | 24.7 | 263 | 261.0 | 32.1 |
| 24 | 23.8 | 02.9 | 84 | 83.4 | 10.2 | 144 | 142.9 | 17.5 | 204 | 202.5 | 24.9 | 264 | 262.0 | 32.2 |
| 25 | 24.8 | 03.0 | 85 | 84.4 | 10.4 | 145 | 143.9 | 17.7 | 205 | 203.5 | 25.0 | 265 | 263.0 | 32.3 |
| 26 | 25.8 | 03.2 | 86 | 85.4 | 10.5 | 146 | 144.9 | 17.8 | 206 | 204.5 | 25.1 | 266 | 264.0 | 32.4 |
| 27 | 26.8 | 03.3 | 87 | 86.4 | 10.6 | 147 | 145.9 | 17.9 | 207 | 205.5 | 25.2 | 267 | 265.0 | 32.5 |
| 28 | 27.8 | 03.4 | 88 | 87.3 | 10.7 | 148 | 146.9 | 18.0 | 208 | 206.4 | 25.3 | 268 | 266.0 | 32.7 |
| 29 | 28.8 | 03.5 | 89 | 88.3 | 10.8 | 149 | 147.9 | 18.2 | 209 | 207.4 | 25.5 | 269 | 267.0 | 32.8 |
| 30 | 29.8 | 03.7 | 90 | 89.3 | 11.0 | 150 | 148.9 | 18.3 | 210 | 208.4 | 25.6 | 270 | 268.0 | 32.9 |
| 31 | 30.8 | 03.8 | 91 | 90.3 | 11.1 | 151 | 149.9 | 18.4 | 211 | 209.4 | 25.7 | 271 | 269.0 | 33.0 |
| 32 | 31.8 | 03.9 | 92 | 91.3 | 11.2 | 152 | 150.9 | 18.5 | 212 | 210.4 | 25.8 | 272 | 270.0 | 33.1 |
| 33 | 32.8 | 04.0 | 93 | 92.3 | 11.3 | 153 | 151.9 | 18.6 | 213 | 211.4 | 26.0 | 273 | 271.0 | 33.3 |
| 34 | 33.7 | 04.1 | 94 | 93.3 | 11.5 | 154 | 152.9 | 18.8 | 214 | 212.4 | 26.1 | 274 | 272.0 | 33.4 |
| 35 | 34.7 | 04.3 | 95 | 94.3 | 11.6 | 155 | 153.8 | 18.9 | 215 | 213.4 | 26.2 | 275 | 273.0 | 33.5 |
| 36 | 35.7 | 04.4 | 96 | 95.3 | 11.7 | 156 | 154.8 | 19.0 | 216 | 214.4 | 26.3 | 276 | 273.9 | 33.6 |
| 37 | 36.7 | 04.5 | 97 | 96.3 | 11.8 | 157 | 155.8 | 19.1 | 217 | 215.4 | 26.4 | 277 | 274.9 | 33.8 |
| 38 | 37.7 | 04.6 | 98 | 97.3 | 11.9 | 158 | 156.8 | 19.3 | 218 | 216.4 | 26.6 | 278 | 275.9 | 33.9 |
| 39 | 38.7 | 04.8 | 99 | 98.3 | 12.1 | 159 | 157.8 | 19.4 | 219 | 217.4 | 26.7 | 279 | 276.9 | 34.0 |
| 40 | 39.7 | 04.9 | 100 | 99.3 | 12.2 | 160 | 158.8 | 19.5 | 220 | 218.4 | 26.8 | 280 | 277.9 | 34.1 |
| 41 | 40.7 | 05.0 | 101 | 100.2 | 12.3 | 161 | 159.8 | 19.6 | 221 | 219.4 | 26.9 | 281 | 278.9 | 34.2 |
| 42 | 41.7 | 05.1 | 102 | 101.2 | 12.4 | 162 | 160.8 | 19.7 | 222 | 220.3 | 27.1 | 282 | 279.9 | 34.4 |
| 43 | 42.7 | 05.2 | 103 | 102.2 | 12.6 | 163 | 161.8 | 19.9 | 223 | 221.3 | 27.2 | 283 | 280.9 | 34.5 |
| 44 | 43.7 | 05.4 | 104 | 103.2 | 12.7 | 164 | 162.8 | 20.0 | 224 | 222.3 | 27.3 | 284 | 281.9 | 34.6 |
| 45 | 44.7 | 05.5 | 105 | 104.2 | 12.8 | 165 | 163.8 | 20.1 | 225 | 223.3 | 27.4 | 285 | 282.9 | 34.7 |
| 46 | 45.7 | 05.6 | 106 | 105.2 | 12.9 | 166 | 164.8 | 20.2 | 226 | 224.3 | 27.5 | 286 | 283.9 | 34.9 |
| 47 | 46.6 | 05.7 | 107 | 106.2 | 13.0 | 167 | 165.8 | 20.4 | 227 | 225.3 | 27.7 | 287 | 284.9 | 35.0 |
| 48 | 47.6 | 05.8 | 108 | 107.2 | 13.2 | 168 | 166.7 | 20.5 | 228 | 226.3 | 27.8 | 288 | 285.9 | 35.1 |
| 49 | 48.6 | 06.0 | 109 | 108.2 | 13.3 | 169 | 167.7 | 20.6 | 229 | 227.3 | 27.9 | 289 | 286.8 | 35.2 |
| 50 | 49.6 | 06.1 | 110 | 109.2 | 13.4 | 170 | 168.7 | 20.7 | 230 | 228.3 | 28.0 | 290 | 287.8 | 35.3 |
| 51 | 50.6 | 06.2 | 111 | 110.2 | 13.5 | 171 | 169.7 | 20.8 | 231 | 229.3 | 28.2 | 291 | 288.8 | 35.5 |
| 52 | 51.6 | 06.3 | 112 | 111.2 | 13.6 | 172 | 170.7 | 21.0 | 232 | 230.3 | 28.3 | 292 | 289.8 | 35.6 |
| 53 | 52.6 | 06.5 | 113 | 112.2 | 13.8 | 173 | 171.7 | 21.1 | 233 | 231.3 | 28.4 | 293 | 290.8 | 35.7 |
| 54 | 53.6 | 06.6 | 114 | 113.2 | 13.9 | 174 | 172.7 | 21.2 | 234 | 232.3 | 28.5 | 294 | 291.8 | 35.8 |
| 55 | 54.6 | 06.7 | 115 | 114.1 | 14.0 | 175 | 173.7 | 21.3 | 235 | 233.2 | 28.6 | 295 | 292.8 | 36.0 |
| 56 | 55.6 | 06.8 | 116 | 115.1 | 14.1 | 176 | 174.7 | 21.4 | 236 | 234.2 | 28.8 | 296 | 293.8 | 36.1 |
| 57 | 56.6 | 06.9 | 117 | 116.1 | 14.3 | 177 | 175.7 | 21.6 | 237 | 235.2 | 28.9 | 297 | 294.8 | 36.2 |
| 58 | 57.6 | 07.1 | 118 | 117.1 | 14.4 | 178 | 176.7 | 21.7 | 238 | 236.2 | 29.0 | 298 | 295.8 | 36.3 |
| 59 | 58.6 | 07.2 | 119 | 118.1 | 14.5 | 179 | 177.7 | 21.8 | 239 | 237.2 | 29.1 | 299 | 296.8 | 36.4 |
| 60 | 59.6 | 07.3 | 120 | 119.1 | 14.6 | 180 | 178.7 | 21.9 | 240 | 238.2 | 29.2 | 300 | 297.8 | 36.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 83 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 8 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.4 | 08.5 | 121 | 119.8 | 16.8 | 181 | 179.2 | 25.2 | 241 | 238.7 | 33.5 |
| 2 | 02.0 | 00.3 | 62 | 61.4 | 08.6 | 122 | 120.8 | 17.0 | 182 | 180.2 | 25.3 | 242 | 239.6 | 33.7 |
| 3 | 03.0 | 00.4 | 63 | 62.4 | 08.8 | 123 | 121.8 | 17.1 | 183 | 181.2 | 25.5 | 243 | 240.6 | 33.8 |
| 4 | 04.0 | 00.6 | 64 | 63.4 | 08.9 | 124 | 122.8 | 17.3 | 184 | 182.2 | 25.6 | 244 | 241.6 | 34 0 |
| 5 | 05.0 | 00.7 | 65 | 64.4 | 09.0 | 125 | 123.8 | 17.4 | 185 | 183.2 | 25.7 | 245 | 242.6 | 34.1 |
| 6 | 05.9 | 00.8 | 66 | 65.4 | 09.2 | 126 | 124.8 | 17.5 | 186 | 184.2 | 25.9 | 246 | 243.6 | 34.2 |
| 7 | 06.9 | 01.0 | 67 | 66.3 | 09.3 | 127 | 125.8 | 17.7 | 187 | 185.2 | 26.0 | 247 | 244.6 | 34.4 |
| 8 | 07.9 | 01.1 | 68 | 67.3 | 09.5 | 128 | 126.8 | 17.8 | 188 | 186.2 | 26.2 | 248 | 245.6 | 34.5 |
| 9 | 08.9 | 01.3 | 69 | 68.3 | 09.6 | 129 | 127.7 | 18.0 | 189 | 187.2 | 26.3 | 249 | 246.6 | 34.7 |
| 10 | 09.9 | 01.4 | 70 | 69.3 | 09.7 | 130 | 128.7 | 18.1 | 190 | 188.2 | 26.4 | 250 | 247.6 | 34.8 |
| 11 | 10.9 | 01.5 | 71 | 70.3 | 09.9 | 131 | 129.7 | 18.2 | 191 | 189.1 | 26.6 | 251 | 248.6 | 34.9 |
| 12 | 11.9 | 01.7 | 72 | 71.3 | 10.0 | 132 | 130.7 | 18.4 | 192 | 190.1 | 26.7 | 252 | 249.5 | 35.1 |
| 13 | 12.9 | 01.8 | 73 | 72.3 | 10.2 | 133 | 131.7 | 18.5 | 193 | 191.1 | 26.9 | 253 | 250.5 | 35.2 |
| 14 | 13.9 | 01.9 | 74 | 73.3 | 10.3 | 134 | 132.7 | 18.6 | 194 | 192.1 | 27.0 | 254 | 251.5 | 35.3 |
| 15 | 14.8 | 02.1 | 75 | 74.3 | 10.4 | 135 | 133.7 | 18.8 | 195 | 193.1 | 27.1 | 255 | 252.5 | 35.5 |
| 16 | 15.8 | 02.2 | 76 | 75.3 | 10.6 | 136 | 134.7 | 18.9 | 196 | 194.1 | 27.3 | 256 | 253.5 | 35.6 |
| 17 | 16.8 | 02.4 | 77 | 76.3 | 10.7 | 137 | 135.7 | 19.1 | 197 | 195.1 | 27.4 | 257 | 254.5 | 35.8 |
| 18 | 17.8 | 02.5 | 78 | 77.2 | 10.9 | 138 | 136.7 | 19.2 | 198 | 196.1 | 27.6 | 258 | 255.5 | 35.9 |
| 19 | 18.8 | 02.6 | 79 | 78.2 | 11.0 | 139 | 137.7 | 19.3 | 199 | 197.1 | 27.7 | 259 | 256.5 | 56.0 |
| 20 | 19.8 | 02.8 | 80 | 79.2 | 11.1 | 140 | 138.6 | 19.5 | 200 | 198.1 | 27.8 | 260 | 257.5 | 36.2 |
| 21 | 20.8 | 02.9 | 81 | 80.2 | 11.3 | 141 | 139.6 | 19.6 | 201 | 199.0 | 28.0 | 261 | 258.5 | 36.3 |
| 22 | 21.8 | 03.1 | 82 | 81.2 | 11.4 | 142 | 140·6 | 19.8 | 202 | 200.0 | 28.1 | 262 | 259.5 | 36.5 |
| 23 | 22.8 | 03.2 | 83 | 82.2 | 11.6 | 143 | 141.6 | 19.9 | 203 | 201.0 | 28.3 | 263 | 260.4 | 36.6 |
| 24 | 23.8 | 03.3 | 84 | 83.2 | 11.7 | 144 | 142.6 | 20.0 | 204 | 202.0 | 28.4 | 264 | 261.4 | 36.7 |
| 25 | 24.8 | 03.5 | 85 | 84.2 | 11.8 | 145 | 143.6 | 20.2 | 205 | 203.0 | 28.5 | 265 | 262.4 | 36.9 |
| 26 | 25.7 | 03.6 | 86 | 85.2 | 12.0 | 146 | 144.6 | 20.3 | 206 | 204.0 | 28.7 | 266 | 263.4 | 37.0 |
| 27 | 26.7 | 03.8 | 87 | 86.2 | 12.1 | 147 | 145.6 | 20.5 | 207 | 205.0 | 28.8 | 267 | 264.4 | 37.2 |
| 28 | 27.7 | 03.9 | 88 | 87.1 | 12.2 | 148 | 146.6 | 20.6 | 208 | 206.0 | 28.9 | 268 | 265.4 | 37.3 |
| 29 | 28.7 | 04.0 | 89 | 88.1 | 12.4 | 149 | 147.5 | 20.7 | 209 | 207.0 | 29.1 | 269 | 266.4 | 37.4 |
| 30 | 29.7 | 04.2 | 90 | 89.1 | 12.5 | 150 | 148.5 | 20.9 | 210 | 208.0 | 29.2 | 270 | 267.4 | 37.6 |
| 31 | 30.7 | 04.3 | 91 | 90.1 | 12.7 | 151 | 149.5 | 21.0 | 211 | 208.9 | 29.4 | 271 | 268.4 | 37.7 |
| 32 | 31.7 | 04.5 | 92 | 91.1 | 12.8 | 152 | 150.5 | 21.2 | 212 | 209.9 | 29.5 | 272 | 269.4 | 37.9 |
| 33 | 32.7 | 04.6 | 93 | 92.1 | 12.9 | 153 | 151.5 | 21.3 | 213 | 210.9 | 29.6 | 273 | 270.3 | 38.0 |
| 34 | 33.7 | 04.7 | 94 | 93.1 | 13.1 | 154 | 152.5 | 21.4 | 214 | 211.9 | 29.8 | 274 | 271.3 | 38.1 |
| 35 | 34.7 | 04.9 | 95 | 94.1 | 13.2 | 155 | 153.5 | 21.6 | 215 | 212.9 | 29.9 | 275 | 272.3 | 38.3 |
| 36 | 35.6 | 05.0 | 96 | 95.1 | 13.4 | 156 | 154.5 | 21.7 | 216 | 213.9 | 30.1 | 276 | 273.3 | 38.4 |
| 37 | 36.6 | 05.1 | 97 | 96.1 | 13.5 | 157 | 155.5 | 21.9 | 217 | 214.9 | 30.2 | 277 | 274.3 | 38.6 |
| 38 | 37.6 | 05.3 | 98 | 97.0 | 13.6 | 158 | 156.5 | 22.0 | 218 | 215.9 | 30.3 | 278 | 275.3 | 38.7 |
| 39 | 38.6 | 05.4 | 99 | 98.0 | 13.8 | 159 | 157.5 | 22.1 | 219 | 216.9 | 30.5 | 279 | 276.3 | 38.8 |
| 40 | 39.6 | 05.6 | 100 | 99.0 | 13.9 | 160 | 158.4 | 22.3 | 220 | 217.9 | 30.6 | 280 | 277.3 | 39.0 |
| 41 | 40.6 | 05.7 | 101 | 100.0 | 14.1 | 161 | 159.4 | 22.4 | 221 | 218.8 | 30.8 | 281 | 278.3 | 39.1 |
| 42 | 41.6 | 05.8 | 102 | 101.0 | 14.2 | 162 | 160.4 | 22.5 | 222 | 219.8 | 30.9 | 282 | 279.3 | 39.2 |
| 43 | 42.6 | 06.0 | 103 | 102.0 | 14.3 | 163 | 161.4 | 22.7 | 223 | 220.8 | 31.0 | 283 | 280.2 | 39.4 |
| 44 | 43.6 | 06.1 | 104 | 103.0 | 14.5 | 164 | 162.4 | 22.8 | 224 | 221.8 | 31.2 | 284 | 281.2 | 39.5 |
| 45 | 44.6 | 06.3 | 105 | 104.0 | 14.6 | 165 | 163.4 | 23.0 | 225 | 222.8 | 31.3 | 285 | 282.2 | 39.7 |
| 46 | 45.6 | 06.4 | 106 | 105.0 | 14.8 | 166 | 164.4 | 23.1 | 226 | 223.8 | 31.5 | 286 | 283.2 | 39.8 |
| 47 | 46.5 | 06.5 | 107 | 106.0 | 14.9 | 167 | 165.4 | 23.2 | 227 | 224.8 | 31.6 | 287 | 284.2 | 39.9 |
| 48 | 47.5 | 06.7 | 108 | 106.9 | 15.0 | 168 | 166.4 | 23.4 | 228 | 225.8 | 31.7 | 288 | 285.2 | 40.1 |
| 49 | 48.5 | 06.8 | 109 | 107.9 | 15.2 | 169 | 167.4 | 23.5 | 229 | 226.8 | 31.9 | 289 | 286.2 | 40.2 |
| 50 | 49.5 | 07.0 | 110 | 108.9 | 15.3 | 170 | 168.3 | 23.7 | 230 | 227.8 | 32.0 | 290 | 287.2 | 40.4 |
| 51 | 50.5 | 07.1 | 111 | 109.9 | 15.4 | 171 | 169.3 | 23.8 | 231 | 228.8 | 32.1 | 291 | 288.2 | 40.5 |
| 52 | 51.5 | 07.2 | 112 | 110.9 | 15.6 | 172 | 170.3 | 23.9 | 232 | 229.7 | 32.3 | 292 | 289.2 | 40.6 |
| 53 | 52.5 | 07.4 | 113 | 111.9 | 15.7 | 173 | 171.3 | 24.1 | 233 | 230.7 | 32.4 | 293 | 290.1 | 40.8 |
| 54 | 53.5 | 07.5 | 114 | 112.9 | 15.9 | 174 | 172.3 | 24.2 | 234 | 231.7 | 32.6 | 294 | 291.1 | 40.9 |
| 55 | 54.5 | 07.7 | 115 | 113.9 | 16.0 | 175 | 173.3 | 24.4 | 235 | 232.7 | 32.7 | 295 | 292.1 | 41.1 |
| 56 | 55.5 | 07.8 | 116 | 114.9 | 16.1 | 176 | 174.3 | 24.5 | 236 | 233.7 | 32.8 | 296 | 293.1 | 41.2 |
| 57 | 56.4 | 07.9 | 117 | 115.9 | 16.3 | 177 | 175.3 | 24.6 | 237 | 234.7 | 33.0 | 297 | 294.1 | 41.3 |
| 58 | 57.4 | 08.1 | 118 | 116.9 | 16.4 | 178 | 176.3 | 24.8 | 238 | 235.7 | 33.1 | 298 | 295.1 | 41.5 |
| 59 | 58.4 | 08.2 | 119 | 117.8 | 16.6 | 179 | 177.3 | 24.9 | 239 | 236.7 | 33.3 | 299 | 296.1 | 41.6 |
| 60 | 59.4 | 08.4 | 120 | 118.8 | 16.7 | 180 | 178.2 | 25.1 | 240 | 237.7 | 33.4 | 300 | 297.1 | 41.8 |

## Difference of Latitude and Departure for 9 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 60.2 | 09.5 | 121 | 119.5 | 18.9 | 181 | 178.8 | 28.3 | 241 | 238.0 | 37.7 |
| 2 | 02.0 | 00.3 | 62 | 61.2 | 09.7 | 122 | 120.5 | 19.1 | 182 | 179.8 | 28.5 | 242 | 239.0 | 37.9 |
| 3 | 03.0 | 00.5 | 63 | 62.2 | 09.9 | 123 | 121.5 | 19.2 | 183 | 180.7 | 28.6 | 243 | 240.0 | 38.0 |
| 4 | 04.0 | 00.6 | 64 | 63.2 | 10.0 | 124 | 122.5 | 19.4 | 184 | 181.7 | 28.8 | 244 | 241.0 | 38.2 |
| 5 | 04.9 | 00.8 | 65 | 64.2 | 10.2 | 125 | 123.5 | 19.6 | 185 | 182.7 | 28.9 | 245 | 242.0 | 38.3 |
| 6 | 05.9 | 00.9 | 66 | 65.2 | 10.3 | 126 | 124.4 | 19.7 | 186 | 183.7 | 29.1 | 246 | 243.0 | 38.5 |
| 7 | 06.9 | 01.1 | 67 | 66.2 | 10.5 | 127 | 125.4 | 19.9 | 187 | 184.7 | 29.3 | 247 | 244.0 | 38.6 |
| 8 | 07.9 | 01.3 | 68 | 67.2 | 10.6 | 128 | 126.4 | 20.0 | 188 | 185.7 | 29.4 | 248 | 244.9 | 38.8 |
| 9 | 08.9 | 01.4 | 69 | 68.2 | 10.8 | 129 | 127.4 | 20.2 | 189 | 186.7 | 29.6 | 249 | 245.9 | 39.0 |
| 10 | 09.9 | 01.6 | 70 | 69.1 | 11.0 | 130 | 128.4 | 20.3 | 190 | 187 7 | 29.7 | 250 | 246.9 | 39.1 |
| 11 | 10.9 | 01.7 | 71 | 70.1 | 11.1 | 131 | 129.4 | 20.5 | 191 | 188.6 | 29.9 | 251 | 247.9 | 39.3 |
| 12 | 11.9 | 01.9 | 72 | 71.1 | 11.3 | 132 | 130.4 | 20.6 | 192 | 189.6 | 30.0 | 252 | 248.9 | 39.4 |
| 13 | 12.8 | 02.0 | 73 | 72.1 | 11.4 | 133 | 131.4 | 20.8 | 193 | 190.6 | 30.2 | 253 | 249.9 | 39.6 |
| 14 | 13.8 | 02.2 | 74 | 73.1 | 11.6 | 134 | 132.4 | 21.0 | 194 | 191.6 | 30.3 | 254 | 250.9 | 39.7 |
| 15 | 14.8 | 02.3 | 75 | 74.1 | 11.7 | 135 | 133.3 | 21.1 | 195 | 192.6 | 30.5 | 255 | 251.9 | 39.9 |
| 16 | 15.8 | 02.5 | 76 | 75.1 | 11.9 | 136 | 134.3 | 21.3 | 196 | 193.6 | 30.7 | 256 | 252.8 | 40.0 |
| 17 | 16.8 | 02.7 | 77 | 76.1 | 12.0 | 137 | 135.3 | 21.4 | 197 | 194.6 | 30.8 | 257 | 253.8 | 40.2 |
| 18 | 17.8 | 02.8 | 78 | 77.0 | 12.2 | 138 | 136.3 | 21.6 | 198 | 195.6 | 31.0 | 258 | 254.8 | 40.4 |
| 19 | 18.8 | 03.0 | 79 | 78.0 | 12.4 | 139 | 137.3 | 21.7 | 199 | 196.5 | 31.1 | 259 | 255.8 | 40.5 |
| 20 | 19.8 | 03.1 | 80 | 79.0 | 12.5 | 140 | 138.3 | 21.9 | 200 | 197.5 | 31.3 | 260 | 256.8 | 40.7 |
| 21 | 20.7 | 03.3 | 81 | 80.0 | 12.7 | 141 | 139.3 | 22.1 | 201 | 198.5 | 31.4 | 261 | 257.8 | 40.8 |
| 22 | 21.7 | 03.4 | 82 | 81.0 | 12.8 | 142 | 140.3 | 22.2 | 202 | 199.5 | 31.6 | 262 | 258.8 | 41.0 |
| 23 | 22.7 | 03.6 | 83 | 82.0 | 13.0 | 143 | 141.2 | 22.4 | 203 | 200.5 | 31.8 | 263 | 259.8 | 41.1 |
| 24 | 23.7 | 03.8 | 84 | 83.0 | 13.1 | 144 | 142.2 | 22.5 | 204 | 201.5 | 31.9 | 264 | 260.7 | 41.3 |
| 25 | 24.7 | 03.9 | 85 | 84.0 | 13.3 | 145 | 143.2 | 22.7 | 205 | 202.5 | 32.1 | 265 | 261.7 | 41.5 |
| 26 | 25.7 | 04.1 | 86 | 84.9 | 13.5 | 146 | 144.2 | 22.8 | 206 | 203.5 | 32.2 | 266 | 262.7 | 41.6 |
| 27 | 26.7 | 04.2 | 87 | 85.9 | 13.6 | 147 | 145.2 | 23.0 | 207 | 204.5 | 32.4 | 267 | 263.7 | 41.8 |
| 28 | 27.7 | 04.4 | 88 | 86.9 | 13.8 | 148 | 146.2 | 23.2 | 208 | 205.4 | 32.5 | 268 | 264.7 | 41.9 |
| 29 | 28.6 | 04.5 | 89 | 87.9 | 13.9 | 149 | 147.2 | 23.3 | 209 | 206.4 | 32.7 | 269 | 265.7 | 42.1 |
| 30 | 29.6 | 04.7 | 90 | 88.9 | 14.1 | 150 | 148.2 | 23.5 | 210 | 207.4 | 32.9 | 270 | 266.7 | 42.2 |
| 31 | 30.6 | 04.8 | 91 | 89.9 | 14.2 | 151 | 149.1 | 23.6 | 211 | 208.4 | 33.0 | 271 | 267.7 | 42.4 |
| 32 | 31.6 | 05.0 | 92 | 90.9 | 14.4 | 152 | 150.1 | 23.8 | 212 | 209.4 | 33.2 | 272 | 268.7 | 42.6 |
| 33 | 32.6 | 05.2 | 93 | 91.9 | 14.5 | 153 | 151.1 | 23.9 | 213 | 210.4 | 33.3 | 273 | 269.7 | 42.7 |
| 34 | 33.6 | 05.3 | 94 | 92.8 | 14.7 | 154 | 152.1 | 24.1 | 214 | 211.4 | 33.5 | 274 | 270.6 | 42.9 |
| 35 | 34.6 | 05.5 | 95 | 93.8 | 14.9 | 155 | 153.1 | 24.2 | 215 | 212.4 | 33.6 | 275 | 271.6 | 43.0 |
| 36 | 35.6 | 05.6 | 96 | 94.8 | 15.0 | 156 | 154.1 | 24.4 | 216 | 213.3 | 33.8 | 276 | 272.6 | 43.2 |
| 37 | 36.5 | 05.8 | 97 | 95.8 | 15.2 | 157 | 155.1 | 24.6 | 217 | 214.3 | 33.9 | 277 | 273.6 | 43.3 |
| 38 | 37.5 | 05.9 | 98 | 96.8 | 15.3 | 158 | 156.1 | 24.7 | 218 | 215.3 | 34.1 | 278 | 274.6 | 43.5 |
| 39 | 38.5 | 06.1 | 99 | 97.8 | 15.5 | 159 | 157.0 | 24.9 | 219 | 216.3 | 34.3 | 279 | 275.6 | 43.6 |
| 40 | 39.5 | 06.3 | 100 | 98.8 | 15.6 | 160 | 158.0 | 25.0 | 220 | 217.3 | 34.4 | 280 | 276.6 | 43.8 |
| 41 | 40.5 | 06.4 | 101 | 99.8 | 15.8 | 161 | 159.0 | 25.2 | 221 | 218.3 | 34.6 | 281 | 277.5 | 44.0 |
| 42 | 41.5 | 06.6 | 102 | 100.7 | 16.0 | 162 | 160.0 | 25.3 | 222 | 219.3 | 34.7 | 282 | 278.5 | 44.1 |
| 43 | 42.5 | 06.7 | 103 | 101.7 | 16.1 | 163 | 161.0 | 25.5 | 223 | 220.3 | 34.9 | 283 | 279.5 | 44.3 |
| 44 | 43.5 | 06.9 | 104 | 102.7 | 16.3 | 164 | 162.0 | 25.7 | 224 | 221.2 | 35.0 | 284 | 280.5 | 44.4 |
| 45 | 44.4 | 07.0 | 105 | 103.7 | 16.4 | 165 | 163.0 | 25.8 | 225 | 222.2 | 35.2 | 285 | 281.5 | 44.6 |
| 46 | 45.4 | 07.2 | 106 | 104.7 | 16.6 | 166 | 164.0 | 26.0 | 226 | 223.2 | 35.4 | 286 | 282.5 | 44.7 |
| 47 | 46.4 | 07.4 | 107 | 105.7 | 16.7 | 167 | 164.9 | 26.1 | 227 | 224.2 | 35.5 | 287 | 283.5 | 44.9 |
| 48 | 47.4 | 07.5 | 108 | 106.7 | 16.9 | 168 | 165.9 | 26.3 | 228 | 225.2 | 35.7 | 288 | 284.5 | 45.1 |
| 49 | 48.4 | 07.7 | 109 | 107.7 | 17.1 | 169 | 166.9 | 26.4 | 229 | 226.2 | 35.8 | 289 | 285.4 | 45.2 |
| 50 | 49.4 | 07.8 | 110 | 108.6 | 17.2 | 170 | 167.9 | 26.6 | 230 | 227.2 | 36.0 | 290 | 286.4 | 45.4 |
| 51 | 50.4 | 08.0 | 111 | 109.6 | 17.4 | 171 | 168.9 | 26.8 | 231 | 228.2 | 36.1 | 291 | 287.4 | 45.5 |
| 52 | 51.4 | 08.1 | 112 | 110.6 | 17.5 | 172 | 169.9 | 26.9 | 232 | 229.1 | 36.3 | 292 | 288.4 | 45.7 |
| 53 | 52.3 | 08.3 | 113 | 111.6 | 17.7 | 173 | 170.9 | 27.1 | 233 | 230.1 | 36.4 | 293 | 289.4 | 45.8 |
| 54 | 53.3 | 08.4 | 114 | 112.6 | 17.8 | 174 | 171.9 | 27.2 | 234 | 231.1 | 36.6 | 294 | 290.4 | 46.0 |
| 55 | 54.3 | 08.6 | 115 | 113.6 | 18.0 | 175 | 172.8 | 27.4 | 235 | 232.1 | 36.8 | 295 | 291.4 | 46.1 |
| 56 | 55.3 | 08.8 | 116 | 114.6 | 18.1 | 176 | 173.8 | 27.5 | 236 | 233.1 | 36.9 | 296 | 292.4 | 46.3 |
| 57 | 56.3 | 08.9 | 117 | 115.6 | 18.3 | 177 | 174.8 | 27.7 | 237 | 234.1 | 37.1 | 297 | 293.4 | 46.5 |
| 58 | 57.3 | 09.1 | 118 | 116.5 | 18.5 | 178 | 175.8 | 27.8 | 238 | 235.1 | 37.2 | 298 | 294.3 | 46.6 |
| 59 | 58.3 | 09.2 | 119 | 117.5 | 18.6 | 179 | 176.8 | 28.0 | 239 | 236.1 | 37.4 | 299 | 295.3 | 46.8 |
| 60 | 59.3 | 09.4 | 120 | 118.5 | 18.8 | 180 | 177.8 | 28.2 | 240 | 237.0 | 37.5 | 300 | 296.3 | 46.9 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 8 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.1 | 61 | 60.4 | 08.5 | 121 | 119.8 | 16.8 | 181 | 179.2 | 25.2 | 241 | 238.7 | 33.5 |
| 2 | 02.0 | 00.3 | 62 | 61.4 | 08.6 | 122 | 120.8 | 17.0 | 182 | 180.2 | 25.3 | 242 | 239.6 | 33.7 |
| 3 | 03.0 | 00.4 | 63 | 62.4 | 08.8 | 123 | 121.8 | 17.1 | 183 | 181.2 | 25.5 | 243 | 240.6 | 33.8 |
| 4 | 04.0 | 00.6 | 64 | 63.4 | 08.9 | 124 | 122.8 | 17.3 | 184 | 182.2 | 25.6 | 244 | 241.6 | 34 0 |
| 5 | 05.0 | 00.7 | 65 | 64.4 | 09.0 | 125 | 123.8 | 17.4 | 185 | 183.2 | 25.7 | 245 | 242.6 | 34.1 |
| 6 | 05.9 | 00.8 | 66 | 65.4 | 09.2 | 126 | 124.8 | 17.5 | 186 | 184.2 | 25.9 | 246 | 243.6 | 34.2 |
| 7 | 06.9 | 01.0 | 67 | 66.3 | 09.3 | 127 | 125.8 | 17.7 | 187 | 185.2 | 26.0 | 247 | 244.6 | 34.4 |
| 8 | 07.9 | 01.1 | 68 | 67.3 | 09.5 | 128 | 126.8 | 17.8 | 188 | 186.2 | 26.2 | 248 | 245.6 | 34.5 |
| 9 | 08.9 | 01.3 | 69 | 68.3 | 09.6 | 129 | 127.7 | 18.0 | 189 | 187.2 | 26.3 | 249 | 246.6 | 34.7 |
| 10 | 09.9 | 01.4 | 70 | 69.3 | 09.7 | 130 | 128.7 | 18.1 | 190 | 188.2 | 26.4 | 250 | 247.6 | 34.8 |
| 11 | 10.9 | 01.5 | 71 | 70.3 | 09.9 | 131 | 129.7 | 18.2 | 191 | 189.1 | 26.6 | 251 | 248.6 | 34.9 |
| 12 | 11.9 | 01.7 | 72 | 71.3 | 10.0 | 132 | 130.7 | 18.4 | 192 | 190.1 | 26.7 | 252 | 249.5 | 35.1 |
| 13 | 12.9 | 01.8 | 73 | 72.3 | 10.2 | 133 | 131.7 | 18.5 | 193 | 191.1 | 26.9 | 253 | 250.5 | 35.2 |
| 14 | 13.9 | 01.9 | 74 | 73.3 | 10.3 | 134 | 132.7 | 18.6 | 194 | 192.1 | 27.0 | 254 | 251.5 | 35.3 |
| 15 | 14.8 | 02.1 | 75 | 74.3 | 10.4 | 135 | 133.7 | 18.8 | 195 | 193.1 | 27.1 | 255 | 252.5 | 35.5 |
| 16 | 15.8 | 02.2 | 76 | 75.3 | 10.6 | 136 | 134.7 | 18.9 | 196 | 194.1 | 27.3 | 256 | 253.5 | 35.6 |
| 17 | 16.8 | 02.4 | 77 | 76.3 | 10.7 | 137 | 135.7 | 19.1 | 197 | 195.1 | 27.4 | 257 | 254.5 | 35.8 |
| 18 | 17.8 | 02.5 | 78 | 77.2 | 10.9 | 138 | 136.7 | 19.2 | 198 | 196.1 | 27.6 | 258 | 255.5 | 35.9 |
| 19 | 18.8 | 02.6 | 79 | 78.2 | 11.0 | 139 | 137.7 | 19.3 | 199 | 197.1 | 27.7 | 259 | 256.5 | 36.0 |
| 20 | 19.8 | 02.8 | 80 | 79.2 | 11.1 | 140 | 138.6 | 19.5 | 200 | 198.1 | 27.8 | 260 | 257.5 | 36.2 |
| 21 | 20.8 | 02.9 | 81 | 80.2 | 11.3 | 141 | 139.6 | 19.6 | 201 | 199.0 | 28.0 | 261 | 258.5 | 36.3 |
| 22 | 21.8 | 03.1 | 82 | 81.2 | 11.4 | 142 | 140·6 | 19.8 | 202 | 200.0 | 28.1 | 262 | 259.5 | 36.5 |
| 23 | 22.8 | 03.2 | 83 | 82.2 | 11.6 | 143 | 141.6 | 19.9 | 203 | 201.0 | 28.3 | 263 | 260.4 | 36.6 |
| 24 | 23.8 | 03.3 | 84 | 83.2 | 11.7 | 144 | 142.6 | 20.0 | 204 | 202.0 | 28.4 | 264 | 261.4 | 36.7 |
| 25 | 24.8 | 03.5 | 85 | 84.2 | 11.8 | 145 | 143.6 | 20.2 | 205 | 203.0 | 28.5 | 265 | 262.4 | 36.9 |
| 26 | 25.7 | 03.6 | 86 | 85.2 | 12.0 | 146 | 144.6 | 20.3 | 206 | 204.0 | 28.7 | 266 | 263.4 | 37.0 |
| 27 | 26.7 | 03.8 | 87 | 86.2 | 12.1 | 147 | 145.6 | 20.5 | 207 | 205.0 | 28.8 | 267 | 264.4 | 37.2 |
| 28 | 27.7 | 03.9 | 88 | 87.1 | 12.2 | 148 | 146.6 | 20.6 | 208 | 206.0 | 28.9 | 268 | 265.4 | 37.3 |
| 29 | 28.7 | 04.0 | 89 | 88.1 | 12.4 | 149 | 147.5 | 20.7 | 209 | 207.0 | 29.1 | 269 | 266.4 | 37.4 |
| 30 | 29.7 | 04.2 | 90 | 89.1 | 12.5 | 150 | 148.5 | 20.9 | 210 | 208.0 | 29.2 | 270 | 267.4 | 37.6 |
| 31 | 30.7 | 04.3 | 91 | 90.1 | 12.7 | 151 | 149.5 | 21.0 | 211 | 208.9 | 29.4 | 271 | 268.4 | 37.7 |
| 32 | 31.7 | 04.5 | 92 | 91.1 | 12.8 | 152 | 150.5 | 21.2 | 212 | 209.9 | 29.5 | 272 | 269.4 | 37.9 |
| 33 | 32.7 | 04.6 | 93 | 92.1 | 12.9 | 153 | 151.5 | 21.3 | 213 | 210.9 | 29.6 | 273 | 270.3 | 38.0 |
| 34 | 33.7 | 04.7 | 94 | 93.1 | 13.1 | 154 | 152.5 | 21.4 | 214 | 211.9 | 29.8 | 274 | 271.3 | 38.1 |
| 35 | 34.7 | 04.9 | 95 | 94.1 | 13.2 | 155 | 153.5 | 21.6 | 215 | 212.9 | 29.9 | 275 | 272.3 | 38.3 |
| 36 | 35.6 | 05.0 | 96 | 95.1 | 13.4 | 156 | 154.5 | 21.7 | 216 | 213.9 | 30.1 | 276 | 273.3 | 38.4 |
| 37 | 36.6 | 05.1 | 97 | 96.1 | 13.5 | 157 | 155.5 | 21.9 | 217 | 214.9 | 30.2 | 277 | 274.3 | 38.6 |
| 38 | 37.6 | 05.3 | 98 | 97.0 | 13.6 | 158 | 156.5 | 22.0 | 218 | 215.9 | 30.3 | 278 | 275.3 | 38.7 |
| 39 | 38.6 | 05.4 | 99 | 98.0 | 13.8 | 159 | 157.5 | 22.1 | 219 | 216.9 | 30.5 | 279 | 276.3 | 38.8 |
| 40 | 39.6 | 05.6 | 100 | 99.0 | 13.9 | 160 | 158.4 | 22.3 | 220 | 217.9 | 30.6 | 280 | 277.3 | 39.0 |
| 41 | 40.6 | 05.7 | 101 | 100.0 | 14.1 | 161 | 159.4 | 22.4 | 221 | 218.8 | 30.8 | 281 | 278.3 | 39.1 |
| 42 | 41.6 | 05.8 | 102 | 101.0 | 14.2 | 162 | 160.4 | 22.5 | 222 | 219.8 | 30.9 | 282 | 279.3 | 39.2 |
| 43 | 42.6 | 06.0 | 103 | 102.0 | 14.3 | 163 | 161.4 | 22.7 | 223 | 220.8 | 31.0 | 283 | 280.2 | 39.4 |
| 44 | 43.6 | 06.1 | 104 | 103.0 | 14.5 | 164 | 162.4 | 22.8 | 224 | 221.8 | 31.2 | 284 | 281.2 | 39.5 |
| 45 | 44.6 | 06.3 | 105 | 104.0 | 14.6 | 165 | 163.4 | 23.0 | 225 | 222.8 | 31.3 | 285 | 282.2 | 39.7 |
| 46 | 45.6 | 06.4 | 106 | 105.0 | 14.8 | 166 | 164.4 | 23.1 | 226 | 223.8 | 31.5 | 286 | 283.2 | 39.8 |
| 47 | 46.5 | 06.5 | 107 | 106.0 | 14.9 | 167 | 165.4 | 23.2 | 227 | 224.8 | 31.6 | 287 | 284.2 | 39.9 |
| 48 | 47.5 | 06.7 | 108 | 106.9 | 15.0 | 168 | 166.4 | 23.4 | 228 | 225.8 | 31.7 | 288 | 285.2 | 40.1 |
| 49 | 48.5 | 06.8 | 109 | 107.9 | 15.2 | 169 | 167.4 | 23.5 | 229 | 226.8 | 31.9 | 289 | 286.2 | 40.2 |
| 50 | 49.5 | 07.0 | 110 | 108.9 | 15.3 | 170 | 168.3 | 23.7 | 230 | 227.8 | 32.0 | 290 | 287.2 | 40.4 |
| 51 | 50.5 | 07.1 | 111 | 109.9 | 15.4 | 171 | 169.3 | 23.8 | 231 | 228.8 | 32.1 | 291 | 288.2 | 40.5 |
| 52 | 51.5 | 07.2 | 112 | 110.9 | 15.6 | 172 | 170.3 | 23.9 | 232 | 229.7 | 32.3 | 292 | 289.2 | 40.6 |
| 53 | 52.5 | 07.4 | 113 | 111.9 | 15.7 | 173 | 171.3 | 24.1 | 233 | 230.7 | 32.4 | 293 | 290.1 | 40.8 |
| 54 | 53.5 | 07.5 | 114 | 112.9 | 15.9 | 174 | 172.3 | 24.2 | 234 | 231.7 | 32.6 | 294 | 291.1 | 40.9 |
| 55 | 54.5 | 07.7 | 115 | 113.9 | 16.0 | 175 | 173.3 | 24.4 | 235 | 232.7 | 32.7 | 295 | 292.1 | 41.1 |
| 56 | 55.5 | 07.8 | 116 | 114.9 | 16.1 | 176 | 174.3 | 24.5 | 236 | 233.7 | 32.8 | 296 | 293.1 | 41.2 |
| 57 | 56.4 | 07.9 | 117 | 115.9 | 16.3 | 177 | 175.3 | 24.6 | 237 | 234.7 | 33.0 | 297 | 294.1 | 41.3 |
| 58 | 57.4 | 08.1 | 118 | 116.9 | 16.4 | 178 | 176.3 | 24.8 | 238 | 235.7 | 33.1 | 298 | 295.1 | 41.5 |
| 59 | 58.4 | 08.2 | 119 | 117.8 | 16.6 | 179 | 177.3 | 24.9 | 239 | 236.7 | 33.3 | 299 | 296.1 | 41.6 |
| 60 | 59.4 | 08.4 | 120 | 118.8 | 16.7 | 180 | 178.2 | 25.1 | 240 | 237.7 | 33.4 | 300 | 297.1 | 41.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

## Difference of Latitude and Departure for 9 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 60.2 | 09.5 | 121 | 119.5 | 18.9 | 181 | 178.8 | 28.3 | 241 | 238.0 | 37.7 |
| 2 | 02.0 | 00.3 | 62 | 61.2 | 09.7 | 122 | 120.5 | 19.1 | 182 | 179.8 | 28.5 | 242 | 239.0 | 37.9 |
| 3 | 03.0 | 00.5 | 63 | 62.2 | 09.9 | 123 | 121.5 | 19.2 | 183 | 180.7 | 28.6 | 243 | 240.0 | 38.0 |
| 4 | 04.0 | 00.6 | 64 | 63.2 | 10.0 | 124 | 122.5 | 19.4 | 184 | 181.7 | 28.8 | 244 | 241.0 | 38.2 |
| 5 | 04.9 | 00.8 | 65 | 64.2 | 10.2 | 125 | 123.5 | 19.6 | 185 | 182.7 | 28.9 | 245 | 242.0 | 38.3 |
| 6 | 05.9 | 00.9 | 66 | 65.2 | 10.3 | 126 | 124.4 | 19.7 | 186 | 183.7 | 29.1 | 246 | 243.0 | 38.5 |
| 7 | 06.9 | 01.1 | 67 | 66.2 | 10.5 | 127 | 125.4 | 19.9 | 187 | 184.7 | 29.3 | 247 | 244.0 | 38.6 |
| 8 | 07.9 | 01.3 | 68 | 67.2 | 10.6 | 128 | 126.4 | 20.0 | 188 | 185.7 | 29.4 | 248 | 244.9 | 38.8 |
| 9 | 08.9 | 01.4 | 69 | 68.2 | 10.8 | 129 | 127.4 | 20.2 | 189 | 186.7 | 29.6 | 249 | 245.9 | 39.0 |
| 10 | 09.9 | 01.6 | 70 | 69.1 | 11.0 | 130 | 128.4 | 20.3 | 190 | 187 7 | 29.7 | 250 | 246.9 | 39.1 |
| 11 | 10.9 | 01.7 | 71 | 70.1 | 11.1 | 131 | 129.4 | 20.5 | 191 | 188.6 | 29.9 | 251 | 247.9 | 39.3 |
| 12 | 11.9 | 01.9 | 72 | 71.1 | 11.3 | 132 | 130.4 | 20.6 | 192 | 189.6 | 30.0 | 252 | 248.9 | 39.4 |
| 13 | 12.8 | 02.0 | 73 | 72.1 | 11.4 | 133 | 131.4 | 20.8 | 193 | 190.6 | 30.2 | 253 | 249.9 | 39.6 |
| 14 | 13.8 | 02.2 | 74 | 73.1 | 11.6 | 134 | 132.4 | 21.0 | 194 | 191.6 | 30.3 | 254 | 250.9 | 39.7 |
| 15 | 14.8 | 02.3 | 75 | 74.1 | 11.7 | 135 | 133.3 | 21.1 | 195 | 192.6 | 30.5 | 255 | 251.9 | 39.9 |
| 16 | 15.8 | 02.5 | 76 | 75.1 | 11.9 | 136 | 134.3 | 21.3 | 196 | 193.6 | 30.7 | 256 | 252.8 | 40.0 |
| 17 | 16.8 | 02.7 | 77 | 76.1 | 12.0 | 137 | 135.3 | 21.4 | 197 | 194.6 | 30.8 | 257 | 253.8 | 40.2 |
| 18 | 17.8 | 02.8 | 78 | 77.0 | 12.2 | 138 | 136.3 | 21.6 | 198 | 195.6 | 31.0 | 258 | 254.8 | 40.4 |
| 19 | 18.8 | 03.0 | 79 | 78.0 | 12.4 | 139 | 137.3 | 21.7 | 199 | 196.5 | 31.1 | 259 | 255.8 | 40.5 |
| 20 | 19.8 | 03.1 | 80 | 79.0 | 12.5 | 140 | 138.3 | 21.9 | 200 | 197.5 | 31.3 | 260 | 256.8 | 40.7 |
| 21 | 20.7 | 03.3 | 81 | 80.0 | 12.7 | 141 | 139.3 | 22.1 | 201 | 198.5 | 31.4 | 261 | 257.8 | 40.8 |
| 22 | 21.7 | 03.4 | 82 | 81.0 | 12.8 | 142 | 140.3 | 22.2 | 202 | 199.5 | 31.6 | 262 | 258.8 | 41.0 |
| 23 | 22.7 | 03.6 | 83 | 82.0 | 13.0 | 143 | 141.2 | 22.4 | 203 | 200.5 | 31.8 | 263 | 259.8 | 41.1 |
| 24 | 23.7 | 03.8 | 84 | 83.0 | 13.1 | 144 | 142.2 | 22.5 | 204 | 201.5 | 31.9 | 264 | 260.7 | 41.3 |
| 25 | 24.7 | 03.9 | 85 | 84.0 | 13.3 | 145 | 143.2 | 22.7 | 205 | 202.5 | 32.1 | 265 | 261.7 | 41.5 |
| 26 | 25.7 | 04.1 | 86 | 84.9 | 13.5 | 146 | 144.2 | 22.8 | 206 | 203.5 | 32.2 | 266 | 262.7 | 41.6 |
| 27 | 26.7 | 04.2 | 87 | 85.9 | 13.6 | 147 | 145.2 | 23.0 | 207 | 204.5 | 32.4 | 267 | 263.7 | 41.8 |
| 28 | 27.7 | 04.4 | 88 | 86.9 | 13.8 | 148 | 146.2 | 23.2 | 208 | 205.4 | 32.5 | 268 | 264.7 | 41.9 |
| 29 | 28.6 | 04·5 | 89 | 87.9 | 13.9 | 149 | 147.2 | 23.3 | 209 | 206.4 | 32.7 | 269 | 265.7 | 42.1 |
| 30 | 29.6 | 04.7 | 90 | 88.9 | 14.1 | 150 | 148.2 | 23.5 | 210 | 207.4 | 32.9 | 270 | 266.7 | 42.2 |
| 31 | 30.6 | 04.8 | 91 | 89.9 | 14.2 | 151 | 149.1 | 23.6 | 211 | 208.4 | 33.0 | 271 | 267.7 | 42.4 |
| 32 | 31.6 | 05.0 | 92 | 90.9 | 14.4 | 152 | 150.1 | 23.8 | 212 | 209.4 | 33.2 | 272 | 268.7 | 42.6 |
| 33 | 32.6 | 05.2 | 93 | 91.9 | 14.5 | 153 | 151.1 | 23.9 | 213 | 210.4 | 33.3 | 273 | 269.7 | 42.7 |
| 34 | 33.6 | 05.3 | 94 | 92.8 | 14.7 | 154 | 152.1 | 24.1 | 214 | 211.4 | 33.5 | 274 | 270.6 | 42.9 |
| 35 | 34.6 | 05.5 | 95 | 93.8 | 14.9 | 155 | 153.1 | 24.2 | 215 | 212.4 | 33.6 | 275 | 271.6 | 43.0 |
| 36 | 35.6 | 05.6 | 96 | 94.8 | 15.0 | 156 | 154.1 | 24.4 | 216 | 213.3 | 33.8 | 276 | 272.6 | 43.2 |
| 37 | 36.5 | 05.8 | 97 | 95.8 | 15.2 | 157 | 155.1 | 24.6 | 217 | 214.3 | 33.9 | 277 | 273.6 | 43.3 |
| 38 | 37.5 | 05.9 | 98 | 96.8 | 15.3 | 158 | 156.1 | 24.7 | 218 | 215.3 | 34.1 | 278 | 274.6 | 43.5 |
| 39 | 38.5 | 06.1 | 99 | 97.8 | 15.5 | 159 | 157.0 | 24.9 | 219 | 216.3 | 34.3 | 279 | 275.6 | 43.6 |
| 40 | 39.5 | 06.3 | 100 | 98.8 | 15.6 | 160 | 158.0 | 25.0 | 220 | 217.3 | 34.4 | 280 | 276.6 | 43.8 |
| 41 | 40.5 | 06.4 | 101 | 99.8 | 15.8 | 161 | 159.0 | 25.2 | 221 | 218.3 | 34.6 | 281 | 277.5 | 44.0 |
| 42 | 41.5 | 06.6 | 102 | 100.7 | 16.0 | 162 | 160.0 | 25.3 | 222 | 219.3 | 34.7 | 282 | 278.5 | 44.1 |
| 43 | 42.5 | 06.7 | 103 | 101.7 | 16.1 | 163 | 161.0 | 25.5 | 223 | 220.3 | 34.9 | 283 | 279.5 | 44.3 |
| 44 | 43.5 | 06.9 | 104 | 102.7 | 16.3 | 164 | 162.0 | 25.7 | 224 | 221.2 | 35.0 | 284 | 280.5 | 44.4 |
| 45 | 44.4 | 07.0 | 105 | 103.7 | 16.4 | 165 | 163.0 | 25.8 | 225 | 222.2 | 35.2 | 285 | 281.5 | 44.6 |
| 46 | 45.4 | 07.2 | 106 | 104.7 | 16.6 | 166 | 164.0 | 26.0 | 226 | 223.2 | 35.4 | 286 | 282.5 | 44.7 |
| 47 | 46.4 | 07.4 | 107 | 105.7 | 16.7 | 167 | 164.9 | 26.1 | 227 | 224.2 | 35.5 | 287 | 283.5 | 44.9 |
| 48 | 47.4 | 07.5 | 108 | 106.7 | 16.9 | 168 | 165.9 | 26.3 | 228 | 225.2 | 35.7 | 288 | 284.5 | 45.1 |
| 49 | 48.4 | 07.7 | 109 | 107.7 | 17.1 | 169 | 166.9 | 26.4 | 229 | 226.2 | 35.8 | 289 | 285.4 | 45.2 |
| 50 | 49.4 | 07.8 | 110 | 108.6 | 17.2 | 170 | 167.9 | 26.6 | 230 | 227.2 | 36.0 | 290 | 286.4 | 45.4 |
| 51 | 50.4 | 08.0 | 111 | 109.6 | 17.4 | 171 | 168.9 | 26.8 | 231 | 228.2 | 36.1 | 291 | 287.4 | 45.5 |
| 52 | 51.4 | 08.1 | 112 | 110.6 | 17.5 | 172 | 169.9 | 26.9 | 232 | 229.1 | 36.3 | 292 | 288.4 | 45.7 |
| 53 | 52.3 | 08.3 | 113 | 111.6 | 17.7 | 173 | 170.9 | 27.1 | 233 | 230.1 | 36.4 | 293 | 289.4 | 45.8 |
| 54 | 53.3 | 08.4 | 114 | 112.6 | 17.8 | 174 | 171.9 | 27.2 | 234 | 231.1 | 36.6 | 294 | 290.4 | 46.0 |
| 55 | 54.3 | 08.6 | 115 | 113.6 | 18.0 | 175 | 172.8 | 27.4 | 235 | 232.1 | 36.8 | 295 | 291.4 | 46.1 |
| 56 | 55.3 | 08.8 | 116 | 114.6 | 18.1 | 176 | 173.8 | 27.5 | 236 | 233.1 | 36.9 | 296 | 292.4 | 46.3 |
| 57 | 56.3 | 08.9 | 117 | 115.6 | 18.3 | 177 | 174.8 | 27.7 | 237 | 234.1 | 37.1 | 297 | 293.4 | 46.5 |
| 58 | 57.3 | 09.1 | 118 | 116.5 | 18.5 | 178 | 175.8 | 27.8 | 238 | 235.1 | 37.2 | 298 | 294.3 | 46.6 |
| 59 | 58.3 | 09.2 | 119 | 117.5 | 18.6 | 179 | 176.8 | 28.0 | 239 | 236.1 | 37.4 | 299 | 295.3 | 46.8 |
| 60 | 59.3 | 09.4 | 120 | 118.5 | 18.8 | 180 | 177.8 | 28.2 | 240 | 237.0 | 37.5 | 300 | 296.3 | 46.9 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 10 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 60.1 | 10.6 | 121 | 119.2 | 21.0 | 181 | 178.3 | 31.4 | 241 | 237.3 | 41.8 |
| 2 | 02.0 | 00.3 | 62 | 61.1 | 10.8 | 122 | 120.1 | 21.2 | 182 | 179.2 | 31.6 | 242 | 238.3 | 42.0 |
| 3 | 03.0 | 00.5 | 63 | 62.0 | 10.9 | 123 | 121.1 | 21.4 | 183 | 180.2 | 31.8 | 243 | 239.3 | 42.2 |
| 4 | 03.9 | 00.7 | 64 | 63.0 | 11.1 | 124 | 122.1 | 21.5 | 184 | 181.2 | 32.0 | 244 | 240.3 | 42.4 |
| 5 | 04.9 | 00.9 | 65 | 64.0 | 11.3 | 125 | 123.1 | 21.7 | 185 | 182.2 | 32.1 | 245 | 241.3 | 42.5 |
| 6 | 05.9 | 01.0 | 66 | 65.0 | 11.5 | 126 | 124.1 | 21.9 | 186 | 183.2 | 32.3 | 246 | 242.3 | 42.7 |
| 7 | 06.9 | 01.2 | 67 | 66.0 | 11.6 | 127 | 125.1 | 22.1 | 187 | 184.2 | 32.5 | 247 | 243.2 | 42.9 |
| 8 | 07.9 | 01.4 | 68 | 67.0 | 11.8 | 128 | 126.1 | 22.2 | 188 | 185.1 | 32.6 | 248 | 244.2 | 43.1 |
| 9 | 08.9 | 01.6 | 69 | 68.0 | 12.0 | 129 | 127.0 | 22.4 | 189 | 186.1 | 32.8 | 249 | 245.2 | 43.2 |
| 10 | 09.8 | 01.7 | 70 | 68.9 | 12.2 | 130 | 128.0 | 22.6 | 190 | 187.1 | 33.0 | 250 | 246.2 | 43.4 |
| 11 | 10.8 | 01.9 | 71 | 69.9 | 12.3 | 131 | 129.0 | 22.7 | 191 | 188.1 | 33.2 | 251 | 247.2 | 43.6 |
| 12 | 11.8 | 02.1 | 72 | 70.9 | 12.5 | 132 | 130.0 | 22.9 | 192 | 189.1 | 33.3 | 252 | 248.2 | 43.8 |
| 13 | 12.8 | 02.3 | 73 | 71.9 | 12.7 | 133 | 131.0 | 23.1 | 193 | 190.1 | 33.5 | 253 | 249.2 | 43.9 |
| 14 | 13.8 | 02.4 | 74 | 72.9 | 12.8 | 134 | 132.0 | 23.3 | 194 | 191.0 | 33.7 | 254 | 250.1 | 44.1 |
| 15 | 14.8 | 02.6 | 75 | 73.9 | 13.0 | 135 | 132.9 | 23.4 | 195 | 192.0 | 33.9 | 255 | 251.1 | 44.3 |
| 16 | 15.8 | 02.8 | 76 | 74.8 | 13.2 | 136 | 133.9 | 23.6 | 196 | 193.0 | 34.0 | 256 | 252.1 | 44.5 |
| 17 | 16.7 | 03.0 | 77 | 75.8 | 13.4 | 137 | 134.9 | 23.8 | 197 | 194.0 | 34.2 | 257 | 253.1 | 44.6 |
| 18 | 17.7 | 03.1 | 78 | 76.8 | 13.5 | 138 | 135.9 | 24.0 | 198 | 195.0 | 34.4 | 258 | 254.1 | 44.8 |
| 19 | 18.7 | 03.3 | 79 | 77.8 | 13.7 | 139 | 136.9 | 24.1 | 199 | 196.0 | 34.6 | 259 | 255.1 | 45.0 |
| 20 | 19.7 | 03.5 | 80 | 78.8 | 13.9 | 140 | 137.9 | 24.3 | 200 | 197.0 | 34.7 | 260 | 256.1 | 45.1 |
| 21 | 20.7 | 03.6 | 81 | 79.8 | 14.1 | 141 | 138.9 | 24.5 | 201 | 197.9 | 34.9 | 261 | 257.0 | 45.3 |
| 22 | 21.7 | 03.8 | 82 | 80.8 | 14.2 | 142 | 139.8 | 24.7 | 202 | 198.9 | 35.1 | 262 | 258.0 | 45.5 |
| 23 | 22.7 | 04.0 | 83 | 81.7 | 14.4 | 143 | 140.8 | 24.8 | 203 | 199.9 | 35.3 | 263 | 259.0 | 45.7 |
| 24 | 23.6 | 04.2 | 84 | 82.7 | 14.6 | 144 | 141.8 | 25.0 | 204 | 200.9 | 35.4 | 264 | 260.0 | 45.8 |
| 25 | 24.6 | 04.3 | 85 | 83.7 | 14.8 | 145 | 142.8 | 25.2 | 205 | 201.9 | 35.6 | 265 | 261.0 | 46.0 |
| 26 | 25.6 | 04.5 | 86 | 84.7 | 14.9 | 146 | 143.8 | 25.4 | 206 | 202.9 | 35.8 | 266 | 262.0 | 46.2 |
| 27 | 26.6 | 04.7 | 87 | 85.7 | 15.1 | 147 | 144.8 | 25.5 | 207 | 203.9 | 35.9 | 267 | 262.9 | 46.4 |
| 28 | 27.6 | 04.9 | 88 | 86.7 | 15.3 | 148 | 145.8 | 25.7 | 208 | 204.8 | 36.1 | 268 | 263.9 | 46.5 |
| 29 | 28.6 | 05.0 | 89 | 87.6 | 15.5 | 149 | 146.7 | 25.9 | 209 | 205.8 | 36.3 | 269 | 264.9 | 46.7 |
| 30 | 29.5 | 05.2 | 90 | 88.6 | 15.6 | 150 | 147.7 | 26.0 | 210 | 206.8 | 36.5 | 270 | 265.9 | 46.9 |
| 31 | 30.5 | 05.4 | 91 | 89.6 | 15.8 | 151 | 148.7 | 26.2 | 211 | 207.8 | 36.6 | 271 | 266.9 | 47.1 |
| 32 | 31.5 | 05.6 | 92 | 90.6 | 16.0 | 152 | 149.7 | 26.4 | 212 | 208.8 | 36.8 | 272 | 267.9 | 47.2 |
| 33 | 32.5 | 05.7 | 93 | 91.6 | 16.1 | 153 | 150.7 | 26.6 | 213 | 209.8 | 37.0 | 273 | 268.9 | 47.4 |
| 34 | 33.5 | 05.9 | 94 | 92.6 | 16.3 | 154 | 151.7 | 26.7 | 214 | 210.7 | 37.2 | 274 | 269.8 | 47.6 |
| 35 | 34.5 | 06.1 | 95 | 93.6 | 16.5 | 155 | 152.6 | 26.9 | 215 | 211.7 | 37.3 | 275 | 270.8 | 47.8 |
| 36 | 35.5 | 06.3 | 96 | 94.5 | 16.7 | 156 | 153.6 | 27.1 | 216 | 212.7 | 37.5 | 276 | 271.8 | 47.9 |
| 37 | 36.4 | 06.4 | 97 | 95.5 | 16.8 | 157 | 154.6 | 27.3 | 217 | 213.7 | 37.7 | 277 | 272.8 | 48.1 |
| 38 | 37.4 | 06.6 | 98 | 96.5 | 17.0 | 158 | 155.6 | 27.4 | 218 | 214.7 | 37.9 | 278 | 273.8 | 48.3 |
| 39 | 38.4 | 06.8 | 99 | 97.5 | 17.2 | 159 | 156.6 | 27.6 | 219 | 215.7 | 38.0 | 279 | 274.8 | 48.4 |
| 40 | 39.4 | 06.9 | 100 | 98.5 | 17.4 | 160 | 157.6 | 27.8 | 220 | 216.7 | 38.2 | 280 | 275.7 | 48.6 |
| 41 | 40.4 | 07.1 | 101 | 99.5 | 17.5 | 161 | 158.6 | 28.0 | 221 | 217.6 | 38.4 | 281 | 276.7 | 48.8 |
| 42 | 41.4 | 07.3 | 102 | 100.5 | 17.7 | 162 | 159.5 | 28.1 | 222 | 218.6 | 38.5 | 282 | 277.7 | 49.0 |
| 43 | 42.3 | 07.5 | 103 | 101.4 | 17.9 | 163 | 160.5 | 28.3 | 223 | 219.6 | 38.7 | 283 | 278.7 | 49.1 |
| 44 | 43.3 | 07.6 | 104 | 102.4 | 18.1 | 164 | 161.5 | 28.5 | 224 | 220.6 | 38.9 | 284 | 279.7 | 49.3 |
| 45 | 44.3 | 07.8 | 105 | 103.4 | 18.2 | 165 | 162.5 | 28.7 | 225 | 221.6 | 39.1 | 285 | 280.7 | 49.5 |
| 46 | 45.3 | 08.0 | 106 | 104.4 | 18.4 | 166 | 163.5 | 28.8 | 226 | 222.6 | 39.2 | 286 | 281.7 | 49.7 |
| 47 | 46.3 | 08.2 | 107 | 105.4 | 18.6 | 167 | 164.5 | 29.0 | 227 | 223.6 | 39.4 | 287 | 282.6 | 49.8 |
| 48 | 47.3 | 08.3 | 108 | 106.4 | 18.8 | 168 | 165.4 | 29.2 | 228 | 224.5 | 39.6 | 288 | 283.6 | 50.0 |
| 49 | 48.3 | 08.5 | 109 | 107.3 | 18.9 | 169 | 166.4 | 29.3 | 229 | 225.5 | 39.8 | 289 | 284.6 | 50.2 |
| 50 | 49.2 | 08.7 | 110 | 108.3 | 19.1 | 170 | 167.4 | 29.5 | 230 | 226.5 | 39.9 | 290 | 285.6 | 50.4 |
| 51 | 50.2 | 08.9 | 111 | 109.3 | 19.3 | 171 | 168.4 | 29.7 | 231 | 227.5 | 40.1 | 291 | 286.6 | 50.5 |
| 52 | 51.2 | 09.0 | 112 | 110.3 | 19.4 | 172 | 169.4 | 29.9 | 232 | 228.5 | 40.3 | 292 | 287.6 | 50.7 |
| 53 | 52.2 | 09.2 | 113 | 111.3 | 19.6 | 173 | 170.4 | 30.0 | 233 | 229.5 | 40.5 | 293 | 288.5 | 50.9 |
| 54 | 53.2 | 09.4 | 114 | 112.3 | 19.8 | 174 | 171.4 | 30.2 | 234 | 230.4 | 40.6 | 294 | 289.5 | 51.1 |
| 55 | 54.2 | 09.6 | 115 | 113.3 | 20.0 | 175 | 172.3 | 30.4 | 235 | 231.4 | 40.8 | 295 | 290.5 | 51.2 |
| 56 | 55.1 | 09.7 | 116 | 114.2 | 20.1 | 176 | 173.3 | 30.6 | 236 | 232.4 | 41.0 | 296 | 291.5 | 51.4 |
| 57 | 56.1 | 09.9 | 117 | 115.2 | 20.3 | 177 | 174.3 | 30.7 | 237 | 233.4 | 41.2 | 297 | 292.5 | 51.6 |
| 58 | 57.1 | 10.1 | 118 | 116.2 | 20.5 | 178 | 175.3 | 30.9 | 238 | 234.4 | 41.3 | 298 | 293.5 | 51.7 |
| 59 | 58.1 | 10.2 | 119 | 117.2 | 20.7 | 179 | 176.3 | 31.1 | 239 | 235.4 | 41.5 | 299 | 294.5 | 51.9 |
| 60 | 59.1 | 10.4 | 120 | 118.2 | 20.8 | 180 | 177.3 | 31.3 | 240 | 236.4 | 41.7 | 300 | 295.4 | 52.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 11 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 59.9 | 11.6 | 121 | 118.8 | 23.1 | 181 | 177.7 | 34.5 | 241 | 236.6 | 46.0 |
| 2 | 02.0 | 00.4 | 62 | 60.9 | 11.8 | 122 | 119.8 | 23.3 | 182 | 178.7 | 34.7 | 242 | 237.6 | 46.2 |
| 3 | 02.9 | 00.6 | 63 | 61.8 | 12.0 | 123 | 120.7 | 23.5 | 183 | 179.6 | 34.9 | 243 | 238.5 | 46.4 |
| 4 | 03.9 | 00.8 | 64 | 62.8 | 12.2 | 124 | 121.7 | 23.7 | 184 | 180.6 | 35.1 | 244 | 239.5 | 46.6 |
| 5 | 04.9 | 01.0 | 65 | 63.8 | 12.4 | 125 | 122.7 | 23.9 | 185 | 181.6 | 35.3 | 245 | 240.5 | 46.7 |
| 6 | 05.9 | 01.1 | 66 | 64.8 | 12.6 | 126 | 123.7 | 24.0 | 186 | 182.6 | 35.5 | 246 | 241.5 | 46.9 |
| 7 | 06.9 | 01.3 | 67 | 65.8 | 12.8 | 127 | 124.7 | 24.2 | 187 | 183.6 | 35.7 | 247 | 242.5 | 47.1 |
| 8 | 07.9 | 01.5 | 68 | 66.8 | 13.0 | 128 | 125.6 | 24.4 | 188 | 184.5 | 35.9 | 248 | 243.4 | 47.3 |
| 9 | 08.8 | 01.7 | 69 | 67.7 | 13.2 | 129 | 126.6 | 24.6 | 189 | 185.5 | 36.1 | 249 | 244.4 | 47.5 |
| 10 | 09.8 | 01.9 | 70 | 68.7 | 13.4 | 130 | 127.6 | 24.8 | 190 | 186.5 | 36.3 | 250 | 245.4 | 47.7 |
| 11 | 10.8 | 02.1 | 71 | 69.7 | 13.5 | 131 | 128.6 | 25.0 | 191 | 187.5 | 36.4 | 251 | 246.4 | 47.9 |
| 12 | 11.8 | 02.3 | 72 | 70.7 | 13.7 | 132 | 129.6 | 25.2 | 192 | 188.5 | 36.6 | 252 | 247.4 | 48.1 |
| 13 | 12.8 | 02.5 | 73 | 71.7 | 13.9 | 133 | 130.6 | 25.4 | 193 | 189.5 | 36.8 | 253 | 248.4 | 48.3 |
| 14 | 13.7 | 02.7 | 74 | 72.6 | 14.1 | 134 | 131.5 | 25.6 | 194 | 190.4 | 37.0 | 254 | 249.3 | 48.5 |
| 15 | 14.7 | 02.9 | 75 | 73.6 | 14.3 | 135 | 132.5 | 25.8 | 195 | 191.4 | 37.2 | 255 | 250.3 | 48.7 |
| 16 | 15.7 | 03.1 | 76 | 74.6 | 14.5 | 136 | 133.5 | 26.0 | 196 | 192.4 | 37.4 | 256 | 251.3 | 48.8 |
| 17 | 16.7 | 03.2 | 77 | 75.6 | 14.7 | 137 | 134.5 | 26.1 | 197 | 193.4 | 37.6 | 257 | 252.3 | 49.0 |
| 18 | 17.7 | 03.4 | 78 | 76.6 | 14.9 | 138 | 135.5 | 26.3 | 198 | 194.4 | 37.8 | 258 | 253.3 | 49.2 |
| 19 | 18.7 | 03.6 | 79 | 77.5 | 15.1 | 139 | 136.4 | 26.5 | 199 | 195.3 | 38.0 | 259 | 254.2 | 49.4 |
| 20 | 19.6 | 03.8 | 80 | 78.5 | 15.3 | 140 | 137.4 | 26.7 | 200 | 196.3 | 38.2 | 260 | 255.2 | 49.6 |
| 21 | 20.6 | 04.0 | 81 | 79.5 | 15.5 | 141 | 138.4 | 26.9 | 201 | 197.3 | 38.4 | 261 | 256.2 | 49.8 |
| 22 | 21.6 | 04.2 | 82 | 80.5 | 15.6 | 142 | 139.4 | 27.1 | 202 | 198.3 | 38.5 | 262 | 257.2 | 50.0 |
| 23 | 22.6 | 04.4 | 83 | 81.5 | 15.8 | 143 | 140.4 | 27.3 | 203 | 199.3 | 38.7 | 263 | 258.2 | 50.2 |
| 24 | 23.6 | 04.6 | 84 | 82.5 | 16.0 | 144 | 141.4 | 27.5 | 204 | 200.3 | 38.9 | 264 | 259.1 | 50.4 |
| 25 | 24.5 | 04.8 | 85 | 83.4 | 16.2 | 145 | 142.3 | 27.7 | 205 | 201.2 | 39.1 | 265 | 260.1 | 50.6 |
| 26 | 25.5 | 05.0 | 86 | 84.4 | 16.4 | 146 | 143.3 | 27.9 | 206 | 202.2 | 39.3 | 266 | 261.1 | 50.8 |
| 27 | 26.5 | 05.2 | 87 | 85.4 | 16.6 | 147 | 144.3 | 28.0 | 207 | 203.2 | 39.5 | 267 | 262.1 | 50.9 |
| 28 | 27.5 | 05.3 | 88 | 86.4 | 16.8 | 148 | 145.3 | 28.2 | 208 | 204.2 | 39.7 | 268 | 263.1 | 51.1 |
| 29 | 28.5 | 05.5 | 89 | 87.4 | 17.0 | 149 | 146.3 | 28.4 | 209 | 205.2 | 39.9 | 269 | 264.1 | 51.3 |
| 30 | 29.4 | 05.7 | 90 | 88.3 | 17.2 | 150 | 147.2 | 28.6 | 210 | 206.1 | 40.1 | 270 | 265.0 | 51.5 |
| 31 | 30.4 | 05.9 | 91 | 89.3 | 17.4 | 151 | 148.2 | 28.8 | 211 | 207.1 | 40.3 | 271 | 266.0 | 51.7 |
| 32 | 31.4 | 06.1 | 92 | 90.3 | 17.6 | 152 | 149.2 | 29.0 | 212 | 208.1 | 40.5 | 272 | 267.0 | 51.9 |
| 33 | 32.4 | 06.3 | 93 | 91.3 | 17.7 | 153 | 150.2 | 29.2 | 213 | 209.1 | 40.6 | 273 | 268.0 | 52.1 |
| 34 | 33.4 | 06.5 | 94 | 92.3 | 17.9 | 154 | 151.2 | 29.4 | 214 | 210.1 | 40.8 | 274 | 269.0 | 52.3 |
| 35 | 34.4 | 06.7 | 95 | 93.3 | 18.1 | 155 | 152.2 | 29.6 | 215 | 211.0 | 41.0 | 275 | 269.9 | 52.5 |
| 36 | 35.3 | 06.9 | 96 | 94.2 | 18.3 | 156 | 153.1 | 29.8 | 216 | 212.0 | 41.2 | 276 | 270.9 | 52.7 |
| 37 | 36.3 | 07.1 | 97 | 95.2 | 18.5 | 157 | 154.1 | 30.0 | 217 | 213.0 | 41.4 | 277 | 271.9 | 52.9 |
| 38 | 37.3 | 07.3 | 98 | 96.2 | 18.7 | 158 | 155.1 | 30.1 | 218 | 214.0 | 41.6 | 278 | 272.9 | 53.0 |
| 39 | 38.3 | 07.4 | 99 | 97.2 | 18.9 | 159 | 156.1 | 30.3 | 219 | 215.0 | 41.8 | 279 | 273.9 | 53.2 |
| 40 | 39.3 | 07.6 | 100 | 98.2 | 19.1 | 160 | 157.1 | 30.5 | 220 | 216.0 | 42.0 | 280 | 274.9 | 53.4 |
| 41 | 40.2 | 07.8 | 101 | 99.1 | 19.3 | 161 | 158.0 | 30.7 | 221 | 216.9 | 42.2 | 281 | 275.8 | 53.6 |
| 42 | 41.2 | 08.0 | 102 | 100.1 | 19.5 | 162 | 159.0 | 30.9 | 222 | 217.9 | 42.4 | 282 | 276.8 | 53.8 |
| 43 | 42.2 | 08.2 | 103 | 101.1 | 19.7 | 163 | 160.0 | 31.1 | 223 | 218.9 | 42.6 | 283 | 277.8 | 54.0 |
| 44 | 43.2 | 08.4 | 104 | 102.1 | 19.8 | 164 | 161.0 | 31.3 | 224 | 219.9 | 42.7 | 284 | 278.8 | 54.2 |
| 45 | 44.2 | 08.6 | 105 | 103.1 | 20.0 | 165 | 162.0 | 31.5 | 225 | 220.9 | 42.9 | 285 | 279.8 | 54.4 |
| 46 | 45.2 | 08.8 | 106 | 104.1 | 20.2 | 166 | 163.0 | 31.7 | 226 | 221.8 | 43.1 | 286 | 280.7 | 54.6 |
| 47 | 46.1 | 09.0 | 107 | 105.0 | 20.4 | 167 | 163.9 | 31.9 | 227 | 222.8 | 43.3 | 287 | 281.7 | 54.8 |
| 48 | 47.1 | 09.2 | 108 | 106.0 | 20.6 | 168 | 164.9 | 32.1 | 228 | 223.8 | 43.5 | 288 | 282.7 | 55.0 |
| 49 | 48.1 | 09.3 | 109 | 107.0 | 20.8 | 169 | 165.9 | 32.2 | 229 | 224.8 | 43.7 | 289 | 283.7 | 55.1 |
| 50 | 49.1 | 09.5 | 110 | 108.0 | 21.0 | 170 | 166.9 | 32.4 | 230 | 225.8 | 43.9 | 290 | 284.7 | 55.3 |
| 51 | 50.1 | 09.7 | 111 | 109.0 | 21.2 | 171 | 167.9 | 32.6 | 231 | 226.8 | 44.1 | 291 | 285.7 | 55.5 |
| 52 | 51.0 | 09.9 | 112 | 109.9 | 21.4 | 172 | 168.8 | 32.8 | 232 | 227.7 | 44.3 | 292 | 286.6 | 55.7 |
| 53 | 52.0 | 10.1 | 113 | 110.9 | 21.6 | 173 | 169.8 | 33.0 | 233 | 228.7 | 44.5 | 293 | 287.6 | 55.9 |
| 54 | 53.0 | 10.3 | 114 | 111.9 | 21.8 | 174 | 170.8 | 33.2 | 234 | 229.7 | 44.6 | 294 | 288.6 | 56.1 |
| 55 | 54.0 | 10.5 | 115 | 112.9 | 21.9 | 175 | 171.8 | 33.4 | 235 | 230.7 | 44.8 | 295 | 289.6 | 56.3 |
| 56 | 55.0 | 10.7 | 116 | 113.9 | 22.1 | 176 | 172.8 | 33.6 | 236 | 231.7 | 45.0 | 296 | 290.6 | 56.5 |
| 57 | 56.0 | 10.9 | 117 | 114.9 | 22.3 | 177 | 173.7 | 33.8 | 237 | 232.6 | 45.2 | 297 | 291.5 | 56.7 |
| 58 | 56.9 | 11.1 | 118 | 115.8 | 22.5 | 178 | 174.7 | 34.0 | 238 | 233.6 | 45.4 | 298 | 292.5 | 56.9 |
| 59 | 57.9 | 11.3 | 119 | 116.8 | 22.7 | 179 | 175.7 | 34.2 | 239 | 234.6 | 45.6 | 299 | 293.5 | 57.1 |
| 60 | 58.9 | 11.4 | 120 | 117.8 | 22.9 | 180 | 176.7 | 34.3 | 240 | 235.6 | 45.8 | 300 | 294.5 | 57.2 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 79 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 12 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 59.7 | 12.7 | 121 | 118.4 | 25.2 | 181 | 177.0 | 37.6 | 241 | 235.7 | 50.1 |
| 2 | 02.0 | 00.4 | 62 | 60.6 | 12.9 | 122 | 119.3 | 25.4 | 182 | 178.0 | 37.8 | 242 | 236.7 | 50.3 |
| 3 | 02.9 | 00.6 | 63 | 61.6 | 13.1 | 123 | 120.3 | 25.6 | 183 | 179.0 | 38.0 | 243 | 237.7 | 50.5 |
| 4 | 03.9 | 00.8 | 64 | 62.6 | 13.3 | 124 | 121.3 | 25.8 | 184 | 180.0 | 38.3 | 244 | 238.7 | 50.7 |
| 5 | 04.9 | 01.0 | 65 | 63.6 | 13.5 | 125 | 122.3 | 26.0 | 185 | 181.0 | 38.5 | 245 | 239.6 | 50.9 |
| 6 | 05.9 | 01.2 | 66 | 64.6 | 13.7 | 126 | 123.2 | 26.2 | 186 | 181 9 | 38.7 | 246 | 240.6 | 51.1 |
| 7 | 06.8 | 01.5 | 67 | 65.5 | 13.9 | 127 | 124.2 | 26.4 | 187 | 182.9 | 38.9 | 247 | 241.6 | 51.4 |
| 8 | 07.8 | 01.7 | 68 | 66.5 | 14.1 | 128 | 125.2 | 26.6 | 188 | 183.9 | 39.1 | 248 | 242.6 | 51.6 |
| 9 | 08.8 | 01.9 | 69 | 67.5 | 14.3 | 129 | 126.2 | 26.8 | 189 | 184.9 | 39.3 | 249 | 243.6 | 51.8 |
| 10 | 09.8 | 02.1 | 70 | 68.5 | 14.6 | 130 | 127.2 | 27.0 | 190 | 185.8 | 39.5 | 250 | 244.5 | 52.0 |
| 11 | 10.8 | 02.3 | 71 | 69.4 | 14.8 | 131 | 128.1 | 27.2 | 191 | 186.8 | 39.7 | 251 | 245.5 | 52.2 |
| 12 | 11.7 | 02.5 | 72 | 70.4 | 15.0 | 132 | 129.1 | 27.4 | 192 | 187.8 | 39.9 | 252 | 246.5 | 52.4 |
| 13 | 12.7 | 02.7 | 73 | 71.4 | 15.2 | 133 | 130.1 | 27.7 | 193 | 188.8 | 40.1 | 253 | 247.5 | 52.6 |
| 14 | 13.7 | 02.9 | 74 | 72.4 | 15.4 | 134 | 131.1 | 27.9 | 194 | 189.8 | 40.3 | 254 | 248.4 | 52.8 |
| 15 | 14.7 | 03.1 | 75 | 73.4 | 15.6 | 135 | 132.0 | 28.1 | 195 | 190.7 | 40.5 | 255 | 249.4 | 53.0 |
| 16 | 15.7 | 03.3 | 76 | 74.3 | 15.8 | 136 | 133.0 | 28.3 | 196 | 191.7 | 40.8 | 256 | 250.4 | 53.2 |
| 17 | 16.6 | 03.5 | 77 | 75.3 | 16.0 | 137 | 134.0 | 28.5 | 197 | 192.7 | 41.0 | 257 | 251.4 | 53.4 |
| 18 | 17.6 | 03.7 | 78 | 76.3 | 16.2 | 138 | 135.0 | 28.7 | 198 | 193.7 | 41.2 | 258 | 252.4 | 53.6 |
| 19 | 18.6 | 04.0 | 79 | 77.3 | 16.4 | 139 | 136.0 | 28.9 | 199 | 194.7 | 41.4 | 259 | 253.3 | 53.8 |
| 20 | 19.6 | 04.2 | 80 | 78.3 | 16.6 | 140 | 136.9 | 29.1 | 200 | 195.6 | 41.6 | 260 | 254.3 | 54.1 |
| 21 | 20.5 | 04.4 | 81 | 79.2 | 16.8 | 141 | 137.9 | 29.3 | 201 | 196.6 | 41.8 | 261 | 255.3 | 54.3 |
| 22 | 21.5 | 04.6 | 82 | 80.2 | 17.0 | 142 | 138.9 | 29.5 | 202 | 197.6 | 42.0 | 262 | 256.3 | 54.5 |
| 23 | 22.5 | 04.8 | 83 | 81.2 | 17.3 | 143 | 139.9 | 29.7 | 203 | 198.6 | 42.2 | 263 | 257.3 | 54.7 |
| 24 | 23.5 | 05.0 | 84 | 82.2 | 17.5 | 144 | 140.9 | 29.9 | 204 | 199.5 | 42.4 | 264 | 258.2 | 54.9 |
| 25 | 24.5 | 05.2 | 85 | 83.1 | 17.7 | 145 | 141.8 | 30.1 | 205 | 200.5 | 42.6 | 265 | 259.2 | 55.1 |
| 26 | 25.4 | 05.4 | 86 | 84.1 | 17.9 | 146 | 142.8 | 30.4 | 206 | 201.5 | 42.8 | 266 | 260.2 | 55.3 |
| 27 | 26.4 | 05.6 | 87 | 85.1 | 18.1 | 147 | 143.8 | 30.6 | 207 | 202.5 | 43.0 | 267 | 261.2 | 55.5 |
| 28 | 27.4 | 05.8 | 88 | 86.1 | 18.3 | 148 | 144.8 | 30.8 | 208 | 203.5 | 43.2 | 268 | 262.1 | 55.7 |
| 29 | 28.4 | 06.0 | 89 | 87.1 | 18.5 | 149 | 145.7 | 31.0 | 209 | 204.4 | 43.5 | 269 | 263.1 | 55.9 |
| 30 | 29.3 | 06.2 | 90 | 88.0 | 18.7 | 150 | 146.7 | 31.2 | 210 | 205.4 | 43.7 | 270 | 264.1 | 56.1 |
| 31 | 30.3 | 06.4 | 91 | 89.0 | 18.9 | 151 | 147.7 | 31.4 | 211 | 206.4 | 43.9 | 271 | 265.1 | 56.3 |
| 32 | 31.3 | 06.7 | 92 | 90.0 | 19.1 | 152 | 148.7 | 31.6 | 212 | 207.4 | 44.1 | 272 | 266.1 | 56.6 |
| 33 | 32.3 | 06.9 | 93 | 91.0 | 19.3 | 153 | 149.7 | 31.8 | 213 | 208.3 | 44.3 | 273 | 267.0 | 56.8 |
| 34 | 33.3 | 07.1 | 94 | 91.9 | 19.5 | 154 | 150.6 | 32.0 | 214 | 209.3 | 44.5 | 274 | 268.0 | 57.0 |
| 35 | 34.2 | 07.3 | 95 | 92.9 | 19.8 | 155 | 151.6 | 32.2 | 215 | 210.3 | 44.7 | 275 | 269.0 | 57.2 |
| 36 | 35.2 | 07.5 | 96 | 93.9 | 20.0 | 156 | 152.6 | 32.4 | 216 | 211.3 | 44.9 | 276 | 270.0 | 57.4 |
| 37 | 36.2 | 07.7 | 97 | 94.9 | 20.2 | 157 | 153.6 | 32.6 | 217 | 212.3 | 45.1 | 277 | 270.9 | 57.6 |
| 38 | 37.2 | 07.9 | 98 | 95.9 | 20.4 | 158 | 154.5 | 32.9 | 218 | 213.2 | 45.3 | 278 | 271.9 | 57.8 |
| 39 | 38.1 | 08.1 | 99 | 96.8 | 20.6 | 159 | 155.5 | 33.1 | 219 | 214.2 | 45.5 | 279 | 272.9 | 58.0 |
| 40 | 39.1 | 08.3 | 100 | 97.8 | 20.8 | 160 | 156.5 | 33.3 | 220 | 215.2 | 45.7 | 280 | 273.9 | 58.2 |
| 41 | 40.1 | 08.5 | 101 | 98.8 | 21.0 | 161 | 157.5 | 33.5 | 221 | 216.2 | 45.9 | 281 | 274.9 | 58.4 |
| 42 | 41.1 | 08.7 | 102 | 99.8 | 21.2 | 162 | 158.5 | 33.7 | 222 | 217.1 | 46.2 | 282 | 275.8 | 58.6 |
| 43 | 42.1 | 08.9 | 103 | 100.7 | 21.4 | 163 | 159.4 | 33.9 | 223 | 218.1 | 46.4 | 283 | 276.8 | 58.8 |
| 44 | 43.0 | 09.1 | 104 | 101.7 | 21.6 | 164 | 160.4 | 34.1 | 224 | 219.1 | 46.6 | 284 | 277.8 | 59.0 |
| 45 | 44.0 | 09.4 | 105 | 102.7 | 21.8 | 165 | 161.4 | 34.3 | 225 | 220.1 | 46.8 | 285 | 278.8 | 59.3 |
| 46 | 45.0 | 09.6 | 106 | 103.7 | 22.0 | 166 | 162.4 | 34.5 | 226 | 221.1 | 47.0 | 286 | 279.8 | 59.5 |
| 47 | 46.0 | 09.8 | 107 | 104.7 | 22.2 | 167 | 163.4 | 34.7 | 227 | 222.0 | 47.2 | 287 | 280.7 | 59.7 |
| 48 | 47.0 | 10.0 | 108 | 105.6 | 22.5 | 168 | 164.3 | 34.9 | 228 | 223.0 | 47.4 | 288 | 281.7 | 59.9 |
| 49 | 47.9 | 10.2 | 109 | 106.6 | 22.7 | 169 | 165.3 | 35.1 | 229 | 224.0 | 47.6 | 289 | 282.7 | 60.1 |
| 50 | 48.9 | 10.4 | 110 | 107.6 | 22.9 | 170 | 166.3 | 35.3 | 230 | 225.0 | 47.8 | 290 | 283.7 | 60.3 |
| 51 | 49.9 | 10.6 | 111 | 108.6 | 23.1 | 171 | 167.3 | 35.6 | 231 | 226.0 | 48.0 | 291 | 284.6 | 60.5 |
| 52 | 50.9 | 10.8 | 112 | 109.6 | 23.3 | 172 | 168.2 | 35.8 | 232 | 226.9 | 48.2 | 292 | 285.6 | 60.7 |
| 53 | 51.8 | 11.0 | 113 | 110.5 | 23.5 | 173 | 169.2 | 36.0 | 233 | 227.9 | 48.4 | 293 | 286.6 | 60.9 |
| 54 | 52.8 | 11.2 | 114 | 111.5 | 23.7 | 174 | 170.2 | 36.2 | 234 | 228.9 | 48.7 | 294 | 287.6 | 61.1 |
| 55 | 53.8 | 11.4 | 115 | 112.5 | 23.9 | 175 | 171.2 | 36.4 | 235 | 229.9 | 48.9 | 295 | 288.6 | 61.3 |
| 56 | 54.8 | 11.6 | 116 | 113.5 | 24.1 | 176 | 172.2 | 36.6 | 236 | 230.8 | 49.1 | 296 | 289.5 | 61.5 |
| 57 | 55.8 | 11.9 | 117 | 114.4 | 24.3 | 177 | 173.1 | 36.8 | 237 | 231.8 | 49.3 | 297 | 290.5 | 61.7 |
| 58 | 56.7 | 12.1 | 118 | 115.4 | 24.5 | 178 | 174.1 | 37.0 | 238 | 232.8 | 49.5 | 298 | 291.5 | 62.0 |
| 59 | 57.7 | 12.3 | 119 | 116.4 | 24.7 | 179 | 175.1 | 37.2 | 239 | 233.8 | 49.7 | 299 | 292.5 | 62.2 |
| 60 | 58.7 | 12.5 | 120 | 117.4 | 24.9 | 180 | 176.1 | 37.4 | 240 | 234.8 | 49.9 | 300 | 293.4 | 62.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 78 Degrees.

## TABLE II.

### Difference of Latitude and Departure for 13 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 59.4 | 13.7 | 121 | 117.9 | 27.2 | 181 | 176.4 | 40.7 | 241 | 234.8 | 54.2 |
| 2 | 01.9 | 00.4 | 62 | 60.4 | 13.9 | 122 | 118.9 | 27.4 | 182 | 177.3 | 40.9 | 242 | 235.8 | 54.4 |
| 3 | 02.9 | 00.7 | 63 | 61.4 | 14.2 | 123 | 119.8 | 27.7 | 183 | 178.3 | 41.2 | 243 | 236.8 | 54.7 |
| 4 | 03.9 | 00.9 | 64 | 62.4 | 14.4 | 124 | 120.8 | 27.9 | 184 | 179.3 | 41.4 | 244 | 237.7 | 54.9 |
| 5 | 04.9 | 01.1 | 65 | 63.3 | 14.6 | 125 | 121.8 | 28.1 | 185 | 180.3 | 41.6 | 245 | 238.7 | 55.1 |
| 6 | 05.8 | 01.3 | 66 | 64.3 | 14.8 | 126 | 122.8 | 28.3 | 186 | 181.2 | 41.8 | 246 | 239.7 | 55.3 |
| 7 | 06.8 | 01.6 | 67 | 65.3 | 15.1 | 127 | 123.7 | 28.6 | 187 | 182.2 | 42.1 | 247 | 240.7 | 55.6 |
| 8 | 07.8 | 01.8 | 68 | 66.3 | 15.3 | 128 | 124.7 | 28.8 | 188 | 183.2 | 42.3 | 248 | 241.6 | 55.8 |
| 9 | 08.8 | 02.0 | 69 | 67.2 | 15.5 | 129 | 125.7 | 29.0 | 189 | 184.2 | 42.5 | 249 | 242.6 | 56.0 |
| 10 | 09.7 | 02.2 | 70 | 68.2 | 15.7 | 130 | 126.7 | 29.2 | 190 | 185.1 | 42.7 | 250 | 243.6 | 56.2 |
| 11 | 10.7 | 02.5 | 71 | 69.2 | 16.0 | 131 | 127.6 | 29.5 | 191 | 186.1 | 43.0 | 251 | 244.6 | 56.5 |
| 12 | 11.7 | 02.7 | 72 | 70.2 | 16.2 | 132 | 128.6 | 29.7 | 192 | 187.1 | 43.2 | 252 | 245.5 | 56.7 |
| 13 | 12.7 | 02.9 | 73 | 71.1 | 16.4 | 133 | 129.6 | 29.9 | 193 | 188.1 | 43.4 | 253 | 246.5 | 56.9 |
| 14 | 13.6 | 03.1 | 74 | 72.1 | 16.6 | 134 | 130.6 | 30.1 | 194 | 189.0 | 43.6 | 254 | 247.5 | 57.1 |
| 15 | 14.6 | 03.4 | 75 | 73.1 | 16.9 | 135 | 131.5 | 30.4 | 195 | 190.0 | 43.9 | 255 | 248.5 | 57.4 |
| 16 | 15.6 | 03.6 | 76 | 74.1 | 17.1 | 136 | 132.5 | 30.6 | 196 | 191.0 | 44.1 | 256 | 249.4 | 57.6 |
| 17 | 16.6 | 03.8 | 77 | 75.0 | 17.3 | 137 | 133.5 | 30.8 | 197 | 192.0 | 44.3 | 257 | 250.4 | 57.8 |
| 18 | 17.5 | 04.0 | 78 | 76.0 | 17.5 | 138 | 134.5 | 31.0 | 198 | 192.9 | 44.5 | 258 | 251.4 | 58.0 |
| 19 | 18.5 | 04.3 | 79 | 77.0 | 17.8 | 139 | 135.4 | 31.3 | 199 | 193.9 | 44.8 | 259 | 252.4 | 58.3 |
| 20 | 19.5 | 04.5 | 80 | 77.9 | 18.0 | 140 | 136.4 | 31.5 | 200 | 194.9 | 45.0 | 260 | 253.3 | 58.5 |
| 21 | 20.5 | 04·7 | 81 | 78.9 | 18.2 | 141 | 137.4 | 31.7 | 201 | 195.8 | 45.2 | 261 | 254.3 | 58.7 |
| 22 | 21.4 | 04.9 | 82 | 79.9 | 18.4 | 142 | 138.4 | 31.9 | 202 | 196.8 | 45.4 | 262 | 255.3 | 58.9 |
| 23 | 22.4 | 05.2 | 83 | 80.9 | 18.7 | 143 | 139.3 | 32.2 | 203 | 197.8 | 45.7 | 263 | 256.3 | 59.2 |
| 24 | 23.4 | 05.4 | 84 | 81.8 | 18.9 | 144 | 140.3 | 32.4 | 204 | 198.8 | 45.9 | 264 | 257.2 | 59.4 |
| 25 | 24.4 | 05.6 | 85 | 82.8 | 19.1 | 145 | 141.3 | 32.6 | 205 | 199.7 | 46.1 | 265 | 258.2 | 59.6 |
| 26 | 25.3 | 05.8 | 86 | 83.8 | 19.3 | 146 | 142.3 | 32.8 | 206 | 200.7 | 46.3 | 266 | 259.2 | 59.8 |
| 27 | 26.3 | 06.1 | 87 | 84.8 | 19.6 | 147 | 143.2 | 33.1 | 207 | 201.7 | 46.6 | 267 | 260.2 | 60.1 |
| 28 | 27.3 | 06.3 | 88 | 85.7 | 19.8 | 148 | 144.2 | 33.3 | 208 | 202.7 | 46.8 | 268 | 261.1 | 60.3 |
| 29 | 28.3 | 06.5 | 89 | 86.7 | 20.0 | 149 | 145.2 | 33.5 | 209 | 203.6 | 47.0 | 269 | 262.1 | 60.5 |
| 30 | 29.2 | 06.7 | 90 | 87.7 | 20.2 | 150 | 146.2 | 33.7 | 210 | 204.6 | 47.2 | 270 | 263.1 | 60.7 |
| 31 | 30.2 | 07.0 | 91 | 88.7 | 20.5 | 151 | 147.1 | 34.0 | 211 | 205.6 | 47.5 | 271 | 264.1 | 61.0 |
| 32 | 31.2 | 07.2 | 92 | 89.6 | 20.7 | 152 | 148.1 | 34.2 | 212 | 206.6 | 47.7 | 272 | 265.0 | 61.2 |
| 33 | 32.2 | 07.4 | 93 | 90.6 | 20.9 | 153 | 149.1 | 34.4 | 213 | 207.5 | 47.9 | 273 | 266.0 | 61.4 |
| 34 | 33.1 | 07.6 | 94 | 91.6 | 21.1 | 154 | 150.1 | 34.6 | 214 | 208.5 | 48.1 | 274 | 267.0 | 61.6 |
| 35 | 34.1 | 07.9 | 95 | 92.6 | 21.4 | 155 | 151.0 | 34.9 | 215 | 209.5 | 48.4 | 275 | 268.0 | 61.9 |
| 36 | 35.1 | 08.1 | 96 | 93.5 | 21.6 | 156 | 152.0 | 35.1 | 216 | 210.5 | 48.6 | 276 | 268.9 | 62.1 |
| 37 | 36.1 | 08.3 | 97 | 94.5 | 21.8 | 157 | 153.0 | 35.3 | 217 | 211.4 | 48.8 | 277 | 269.9 | 62.3 |
| 38 | 37.0 | 08.5 | 98 | 95.5 | 22.0 | 158 | 154.0 | 35.5 | 218 | 212.4 | 49.0 | 278 | 270.9 | 62.5 |
| 39 | 38.0 | 08.8 | 99 | 96.5 | 22.3 | 159 | 154.9 | 35.8 | 219 | 213.4 | 49.3 | 279 | 271.8 | 62.8 |
| 40 | 39.0 | 09.0 | 100 | 97.4 | 22.5 | 160 | 155.9 | 36.0 | 220 | 214.4 | 49.5 | 280 | 272.8 | 63.0 |
| 41 | 39.9 | 09.2 | 101 | 98.4 | 22.7 | 161 | 156.9 | 36.2 | 221 | 215.3 | 49.7 | 281 | 273.8 | 63.2 |
| 42 | 40.9 | 09.4 | 102 | 99.4 | 22.9 | 162 | 157.8 | 36.4 | 222 | 216.3 | 49.9 | 282 | 274.8 | 63.4 |
| 43 | 41.9 | 09.7 | 103 | 100.4 | 23.2 | 163 | 158.8 | 36.7 | 223 | 217.3 | 50.2 | 283 | 275.7 | 63.7 |
| 44 | 42.9 | 09.9 | 104 | 101.3 | 23.4 | 164 | 159.8 | 36.9 | 224 | 218.3 | 50.4 | 284 | 276.7 | 63.9 |
| 45 | 43.8 | 10.1 | 105 | 102.3 | 23.6 | 165 | 160.8 | 37.1 | 225 | 219.2 | 50.6 | 285 | 277.7 | 64.1 |
| 46 | 44.8 | 10.3 | 106 | 103.3 | 23.8 | 166 | 161.7 | 37.3 | 226 | 220.2 | 50.8 | 286 | 278.7 | 64.3 |
| 47 | 45.8 | 10.6 | 107 | 104.3 | 24.1 | 167 | 162.7 | 37.6 | 227 | 221.2 | 51.1 | 287 | 279.6 | 64.6 |
| 48 | 46.8 | 10.8 | 108 | 105.2 | 24.3 | 168 | 163.7 | 37.8 | 228 | 222.2 | 51.3 | 288 | 280.6 | 64.8 |
| 49 | 47.7 | 11.0 | 109 | 106.2 | 24.5 | 169 | 164.7 | 38.0 | 229 | 223.1 | 51.5 | 289 | 281.6 | 65.0 |
| 50 | 48.7 | 11.2 | 110 | 107.2 | 24.7 | 170 | 165.6 | 38.2 | 230 | 224.1 | 51.7 | 290 | 282.6 | 65.2 |
| 51 | 49.7 | 11.5 | 111 | 108.2 | 25.0 | 171 | 166.6 | 38.5 | 231 | 225.1 | 52.0 | 291 | 283.5 | 65.5 |
| 52 | 50.7 | 11.7 | 112 | 109.1 | 25.2 | 172 | 167.6 | 38.7 | 232 | 226.1 | 52.2 | 292 | 284.5 | 65.7 |
| 53 | 51.6 | 11.9 | 113 | 110.1 | 25.4 | 173 | 168.6 | 38.9 | 233 | 227.0 | 52.4 | 293 | 285.5 | 65.9 |
| 54 | 52.6 | 12.1 | 114 | 111.1 | 25.6 | 174 | 169.5 | 39.1 | 234 | 228.0 | 52.6 | 294 | 286.5 | 66.1 |
| 55 | 53.6 | 12.4 | 115 | 112.1 | 25.9 | 175 | 170.5 | 39.4 | 235 | 229.0 | 52.9 | 295 | 287.4 | 66.4 |
| 56 | 54.6 | 12.6 | 116 | 113.0 | 26.1 | 176 | 171.5 | 39.6 | 236 | 230.0 | 53.1 | 296 | 288.4 | 66.6 |
| 57 | 55.5 | 12.8 | 117 | 114.0 | 26.3 | 177 | 172.5 | 39.8 | 237 | 230.9 | 53.3 | 297 | 289.4 | 66.8 |
| 58 | 56.5 | 13.0 | 118 | 115.0 | 26.5 | 178 | 173.4 | 40.0 | 238 | 231.9 | 53.5 | 298 | 290.4 | 67.0 |
| 59 | 57.5 | 13.3 | 119 | 116.0 | 26.8 | 179 | 174.4 | 40.3 | 239 | 232.9 | 53.8 | 299 | 291.3 | 67.3 |
| 60 | 58.5 | 13.5 | 120 | 116.9 | 27.0 | 180 | 175.4 | 40.5 | 240 | 233.8 | 54.0 | 300 | 292.3 | 67.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 77 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 14 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 59.2 | 14.8 | 121 | 117.4 | 29.3 | 181 | 175.6 | 43.8 | 241 | 233.8 | 58.3 |
| 2 | 01.9 | 00.5 | 62 | 60.2 | 15.0 | 122 | 118.4 | 29.5 | 182 | 176.6 | 44.0 | 242 | 234.8 | 58.5 |
| 3 | 02.9 | 00.7 | 63 | 61.1 | 15.2 | 123 | 119.3 | 29.8 | 183 | 177.6 | 44.3 | 243 | 235.8 | 58.8 |
| 4 | 03.9 | 01.0 | 64 | 62.1 | 15.5 | 124 | 120.3 | 30.0 | 184 | 178.5 | 44.5 | 244 | 236.8 | 59.0 |
| 5 | 04.9 | 01.2 | 65 | 63.1 | 15.7 | 125 | 121.3 | 30.2 | 185 | 179.5 | 44.8 | 245 | 237.7 | 59.3 |
| 6 | 05.8 | 01.5 | 66 | 64.0 | 16.0 | 126 | 122.3 | 30.5 | 186 | 180.5 | 45.0 | 246 | 238.7 | 59.5 |
| 7 | 06.8 | 01.7 | 67 | 65.0 | 16.2 | 127 | 123.2 | 30.7 | 187 | 181.4 | 45.2 | 247 | 239.7 | 59.8 |
| 8 | 07.8 | 01.9 | 68 | 66.0 | 16.5 | 128 | 124.2 | 31.0 | 188 | 182.4 | 45.5 | 248 | 240.6 | 60.0 |
| 9 | 08.7 | 02.2 | 69 | 67.0 | 16.7 | 129 | 125.2 | 31.2 | 189 | 183.4 | 45.7 | 249 | 241.6 | 60.2 |
| 10 | 09.7 | 02.4 | 70 | 67.9 | 16.9 | 130 | 126.1 | 31.4 | 190 | 184.4 | 46.0 | 250 | 242.6 | 60.5 |
| 11 | 10.7 | 02.7 | 71 | 68.9 | 17.2 | 131 | 127.1 | 31.7 | 191 | 185.3 | 46.2 | 251 | 243.5 | 60.7 |
| 12 | 11.6 | 02.9 | 72 | 69.9 | 17.4 | 132 | 128.1 | 31.9 | 192 | 186.3 | 46.4 | 252 | 244.5 | 61.0 |
| 13 | 12.6 | 03.1 | 73 | 70.8 | 17.7 | 133 | 129.0 | 32.2 | 193 | 187.3 | 46.7 | 253 | 245.5 | 61.2 |
| 14 | 13.6 | 03.4 | 74 | 71.8 | 17.9 | 134 | 130.0 | 32.4 | 194 | 188.2 | 46.9 | 254 | 246.5 | 61.4 |
| 15 | 14.6 | 03.6 | 75 | 72.8 | 18.1 | 135 | 131.0 | 32.7 | 195 | 189.2 | 47.2 | 255 | 247.4 | 61.7 |
| 16 | 15.5 | 03.9 | 76 | 73.7 | 18.4 | 136 | 132.0 | 32.9 | 196 | 190.2 | 47.4 | 256 | 248.4 | 61.9 |
| 17 | 16.5 | 04.1 | 77 | 74.7 | 18.6 | 137 | 132.9 | 33.1 | 197 | 191.1 | 47.7 | 257 | 249.4 | 62.2 |
| 18 | 17.5 | 04.4 | 78 | 75.7 | 18.9 | 138 | 133.9 | 33.4 | 198 | 192.1 | 47.9 | 258 | 250.3 | 62.4 |
| 19 | 18.4 | 04.6 | 79 | 76.7 | 19.1 | 139 | 134.9 | 33.6 | 199 | 193.1 | 48.1 | 259 | 251.3 | 62.7 |
| 20 | 19.4 | 04.8 | 80 | 77.6 | 19.4 | 140 | 135.8 | 33.9 | 200 | 194.1 | 48.4 | 260 | 252.3 | 62.9 |
| 21 | 20.4 | 05.1 | 81 | 78.6 | 19.6 | 141 | 136.8 | 34.1 | 201 | 195.0 | 48.6 | 261 | 253.2 | 63.1 |
| 22 | 21.3 | 05.3 | 82 | 79.6 | 19.8 | 142 | 137.8 | 34.4 | 202 | 196.0 | 48.9 | 262 | 254.2 | 63.4 |
| 23 | 22.3 | 05.6 | 83 | 80.5 | 20.1 | 143 | 138.8 | 34.6 | 203 | 197.0 | 49.1 | 263 | 255.2 | 63.6 |
| 24 | 23.3 | 05.8 | 84 | 81.5 | 20.3 | 144 | 139.7 | 34.8 | 204 | 197.9 | 49.4 | 264 | 256.2 | 63.9 |
| 25 | 24.3 | 06.0 | 85 | 82.5 | 20.6 | 145 | 140.7 | 35.1 | 205 | 198.9 | 49.6 | 265 | 257.1 | 64.1 |
| 26 | 25.2 | 06.3 | 86 | 83.4 | 20.8 | 146 | 141.7 | 35.3 | 206 | 199.9 | 49.8 | 266 | 258.1 | 64.4 |
| 27 | 26.2 | 06.5 | 87 | 84.4 | 21.0 | 147 | 142.6 | 35.6 | 207 | 200.9 | 50.1 | 267 | 259.1 | 64.6 |
| 28 | 27.2 | 06.8 | 88 | 85.4 | 21.3 | 148 | 143.6 | 35.8 | 208 | 201.8 | 50.3 | 268 | 260.0 | 64.8 |
| 29 | 28.1 | 07.0 | 89 | 86.4 | 21.5 | 149 | 144.6 | 36.0 | 209 | 202.8 | 50.6 | 269 | 261.0 | 65.1 |
| 30 | 29.1 | 07.3 | 90 | 87.3 | 21.8 | 150 | 145.5 | 36.3 | 210 | 203.8 | 50.8 | 270 | 262.0 | 65.3 |
| 31 | 30.1 | 07.5 | 91 | 88.3 | 22.0 | 151 | 146.5 | 36.5 | 211 | 204.7 | 51.0 | 271 | 263.0 | 65.6 |
| 32 | 31.0 | 07.7 | 92 | 89.3 | 22.3 | 152 | 147.5 | 36.8 | 212 | 205.7 | 51.3 | 272 | 263.9 | 65.8 |
| 33 | 32.0 | 08.0 | 93 | 90.2 | 22.5 | 153 | 148.5 | 37.0 | 213 | 206.7 | 51.5 | 273 | 264.9 | 66.0 |
| 34 | 33.0 | 08.2 | 94 | 91.2 | 22.7 | 154 | 149.4 | 37.3 | 214 | 207.6 | 51.8 | 274 | 265.9 | 66.3 |
| 35 | 34.0 | 08.5 | 95 | 92.2 | 23.0 | 155 | 150.4 | 37.5 | 215 | 208.6 | 52.0 | 275 | 266.8 | 66.5 |
| 36 | 34.9 | 08.7 | 96 | 93.1 | 23.2 | 156 | 151.4 | 37.7 | 216 | 209.6 | 52.3 | 276 | 267.8 | 66.8 |
| 37 | 35.9 | 09.0 | 97 | 94.1 | 23.5 | 157 | 152.3 | 38.0 | 217 | 210.6 | 52.5 | 277 | 268.8 | 67.0 |
| 38 | 36.9 | 09.2 | 98 | 95.1 | 23.7 | 158 | 153.3 | 38.2 | 218 | 211.5 | 52.7 | 278 | 269.7 | 67.3 |
| 39 | 37.8 | 09.4 | 99 | 96.1 | 24.0 | 159 | 154.3 | 38.5 | 219 | 212.5 | 53.0 | 279 | 270.7 | 67.5 |
| 40 | 38.8 | 09.7 | 100 | 97.0 | 24.2 | 160 | 155.2 | 38.7 | 220 | 213.5 | 53.2 | 280 | 271.7 | 67.7 |
| 41 | 39.8 | 09.9 | 101 | 98.0 | 24.4 | 161 | 156.2 | 38.9 | 221 | 214.4 | 53.5 | 281 | 272.7 | 68.0 |
| 42 | 40.8 | 10.2 | 102 | 99.0 | 24.7 | 162 | 157.2 | 39.2 | 222 | 215.4 | 53.7 | 282 | 273.6 | 68.2 |
| 43 | 41.7 | 10.4 | 103 | 99.9 | 24.9 | 163 | 158.2 | 39.4 | 223 | 216.4 | 53.9 | 283 | 274.6 | 68.5 |
| 44 | 42.7 | 10.6 | 104 | 100.9 | 25.2 | 164 | 159.1 | 39.7 | 224 | 217.3 | 54.2 | 284 | 275.6 | 68.7 |
| 45 | 43.7 | 10.9 | 105 | 101.9 | 25.4 | 165 | 160.1 | 39.9 | 225 | 218.3 | 54.4 | 285 | 276.5 | 68.9 |
| 46 | 44.6 | 11.1 | 106 | 102.9 | 25.6 | 166 | 161.1 | 40.2 | 226 | 219.3 | 54.7 | 286 | 277.5 | 69.2 |
| 47 | 45.6 | 11.4 | 107 | 103.8 | 25.9 | 167 | 162.0 | 40.4 | 227 | 220.3 | 54.9 | 287 | 278.5 | 69.4 |
| 48 | 46.6 | 11.6 | 108 | 104.8 | 26.1 | 168 | 163.0 | 40.6 | 228 | 221.2 | 55.2 | 288 | 279.4 | 69.7 |
| 49 | 47.5 | 11.9 | 109 | 105.8 | 26.4 | 169 | 164.0 | 40.9 | 229 | 222.2 | 55.4 | 289 | 280.4 | 69.9 |
| 50 | 48.5 | 12.1 | 110 | 106.7 | 26.6 | 170 | 165.0 | 41.1 | 230 | 223.2 | 55.6 | 290 | 281.4 | 70 2 |
| 51 | 49.5 | 12.3 | 111 | 107.7 | 26.9 | 171 | 165.9 | 41.4 | 231 | 224.1 | 55.9 | 291 | 282.4 | 70.4 |
| 52 | 50.5 | 12.6 | 112 | 108.7 | 27.1 | 172 | 166.9 | 41.6 | 232 | 225.1 | 56.1 | 292 | 283.3 | 70.6 |
| 53 | 51.4 | 12.8 | 113 | 109.6 | 27.3 | 173 | 167.9 | 41.9 | 233 | 226.1 | 56.4 | 293 | 284.3 | 70.9 |
| 54 | 52.4 | 13.1 | 114 | 110.6 | 27.6 | 174 | 168.8 | 42.1 | 234 | 227.0 | 56.6 | 294 | 285.3 | 71.1 |
| 55 | 53.4 | 13.3 | 115 | 111.6 | 27.8 | 175 | 169.8 | 42.3 | 235 | 228.0 | 56.9 | 295 | 286.2 | 71.4 |
| 56 | 54.3 | 13.5 | 116 | 112.6 | 28.1 | 176 | 170.8 | 42.6 | 236 | 229.0 | 57.1 | 296 | 287.2 | 71.6 |
| 57 | 55.3 | 13.8 | 117 | 113.5 | 28.3 | 177 | 171.7 | 42.8 | 237 | 230.0 | 57.3 | 297 | 288.2 | 71.9 |
| 58 | 56.3 | 14.0 | 118 | 114.5 | 28.6 | 178 | 172.7 | 43.1 | 238 | 230.9 | 57.6 | 298 | 289.1 | 72.1 |
| 59 | 57.2 | 14.3 | 119 | 115.5 | 28.8 | 179 | 173.7 | 43.3 | 239 | 231.9 | 57.8 | 299 | 290.1 | 72.3 |
| 60 | 58.2 | 14.5 | 120 | 116.4 | 29.0 | 180 | 174.7 | 43.5 | 240 | 232.9 | 58.1 | 300 | 291.1 | 72.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

## Difference of Latitude and Departure for 15 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.3 | 61 | 58.9 | 15.8 | 121 | 116.9 | 31.3 | 181 | 174.8 | 46.8 | 241 | 232.8 | 62.4 |
| 2 | 01.9 | 00.5 | 62 | 59.9 | 16.0 | 122 | 117.8 | 31.6 | 182 | 175.8 | 47.1 | 242 | 233.8 | 62.6 |
| 3 | 02.9 | 00.8 | 63 | 60.9 | 16.3 | 123 | 118.8 | 31.8 | 183 | 176.8 | 47.4 | 243 | 234.7 | 62.9 |
| 4 | 03.9 | 01.0 | 64 | 61.8 | 16.6 | 124 | 119.8 | 32.1 | 184 | 177.7 | 47.6 | 244 | 235.7 | 63.2 |
| 5 | 04.8 | 01.3 | 65 | 62.8 | 16.8 | 125 | 120.7 | 32.4 | 185 | 178.7 | 47.9 | 245 | 236.7 | 63.4 |
| 6 | 05.8 | 01.6 | 66 | 63.8 | 17.1 | 126 | 121.7 | 32.6 | 186 | 179.7 | 48.1 | 246 | 237.6 | 63.7 |
| 7 | 06.8 | 01.8 | 67 | 64.7 | 17.3 | 127 | 122.7 | 32.9 | 187 | 180.6 | 48.4 | 247 | 238.6 | 63.9 |
| 8 | 07.7 | 02.1 | 68 | 65.7 | 17.6 | 128 | 123.6 | 33.1 | 188 | 181.6 | 48.7 | 248 | 239.5 | 64.2 |
| 9 | 08.7 | 02.3 | 69 | 66.6 | 17.9 | 129 | 124.6 | 33.4 | 189 | 182.6 | 48.9 | 249 | 240.5 | 64.4 |
| 10 | 09.7 | 02.6 | 70 | 67.6 | 18.1 | 130 | 125.6 | 33.6 | 190 | 183.5 | 49.2 | 250 | 241.5 | 64.7 |
| 11 | 10.6 | 02.8 | 71 | 68.6 | 18.4 | 131 | 126.5 | 33.9 | 191 | 184.5 | 49.4 | 251 | 242.4 | 65.0 |
| 12 | 11.6 | 03.1 | 72 | 69.5 | 18.6 | 132 | 127.5 | 34.2 | 192 | 185.5 | 49.7 | 252 | 243.4 | 65.2 |
| 13 | 12.6 | 03.4 | 73 | 70.5 | 18.9 | 133 | 128.5 | 34.4 | 193 | 186.4 | 50.0 | 253 | 244.4 | 65.5 |
| 14 | 13.5 | 03.6 | 74 | 71.5 | 19.2 | 134 | 129.4 | 34.7 | 194 | 187.4 | 50.2 | 254 | 245.3 | 65.7 |
| 15 | 14.5 | 03.9 | 75 | 72.4 | 19.4 | 135 | 130.4 | 34.9 | 195 | 188.4 | 50.5 | 255 | 246.3 | 66.0 |
| 16 | 15.5 | 04.1 | 76 | 73.4 | 19.7 | 136 | 131.4 | 35.2 | 196 | 189.3 | 50.7 | 256 | 247.3 | 66.3 |
| 17 | 16.4 | 04.4 | 77 | 74.4 | 19.9 | 137 | 132.3 | 35.5 | 197 | 190.3 | 51.0 | 257 | 248.2 | 66.5 |
| 18 | 17.4 | 04.7 | 78 | 75.3 | 20.2 | 138 | 133.3 | 35.7 | 198 | 191.3 | 51.2 | 258 | 249.2 | 66.8 |
| 19 | 18.4 | 04.9 | 79 | 76.3 | 20.4 | 139 | 134.3 | 36.0 | 199 | 192.2 | 51.5 | 259 | 250.2 | 67.0 |
| 20 | 19.3 | 05.2 | 80 | 77.3 | 20.7 | 140 | 135.2 | 36.2 | 200 | 193.2 | 51.8 | 260 | 251.1 | 67.3 |
| 21 | 20.3 | 05.4 | 81 | 78.2 | 21.0 | 141 | 136.2 | 36.5 | 201 | 194.2 | 52.0 | 261 | 252.1 | 67.6 |
| 22 | 21.3 | 05.7 | 82 | 79.2 | 21.2 | 142 | 137.2 | 36.8 | 202 | 195.1 | 52.3 | 262 | 253.1 | 67.8 |
| 23 | 22.2 | 06.0 | 83 | 80.2 | 21 5 | 143 | 138·1 | 37.0 | 203 | 196.1 | 52.5 | 263 | 254.0 | 68.1 |
| 24 | 23.2 | 06.2 | 84 | 81.1 | 21.7 | 144 | 139.1 | 37.3 | 204 | 197.0 | 52.8 | 264 | 255.0 | 68.3 |
| 25 | 24.1 | 06.5 | 85 | 82.1 | 22.0 | 145 | 140.1 | 37.5 | 205 | 198.0 | 53.1 | 265 | 256.0 | 68.6 |
| 26 | 25.1 | 06.7 | 86 | 83.1 | 22.3 | 146 | 141.0 | 37.8 | 206 | 199.0 | 53.3 | 266 | 256.9 | 68.8 |
| 27 | 26.1 | 07.0 | 87 | 84.0 | 22.5 | 147 | 142.0 | 38.0 | 207 | 199.9 | 53.6 | 267 | 257.9 | 69.1 |
| 28 | 27.0 | 07.2 | 88 | 85.0 | 22.8 | 148 | 143.0 | 38.3 | 208 | 200.9 | 53.8 | 268 | 258.9 | 69.4 |
| 29 | 28.0 | 07.5 | 89 | 86.0 | 23.0 | 149 | 143.9 | 38.6 | 209 | 201.9 | 54.1 | 269 | 259.8 | 69.6 |
| 30 | 29.0 | 07.8 | 90 | 86.9 | 23.3 | 150 | 144.9 | 38.8 | 210 | 202.8 | 54.4 | 270 | 260.8 | 69.9 |
| 31 | 29.9 | 08.0 | 91 | 87.9 | 23.6 | 151 | 145.9 | 39.1 | 211 | 203.8 | 54.6 | 271 | 261.8 | 70.1 |
| 32 | 30.9 | 08.3 | 92 | 88.9 | 23.8 | 152 | 146.8 | 39.3 | 212 | 204.8 | 54.9 | 272 | 262.7 | 70.4 |
| 33 | 31.9 | 08.5 | 93 | 89.8 | 24.1 | 153 | 147.8 | 39.6 | 213 | 205.7 | 55.1 | 273 | 263.7 | 70.7 |
| 34 | 32.8 | 08.8 | 94 | 90.8 | 24.3 | 154 | 148.8 | 39.9 | 214 | 206.7 | 55.4 | 274 | 264.7 | 70.9 |
| 35 | 33.8 | 09.1 | 95 | 91.8 | 24.6 | 155 | 149.7 | 40.1 | 215 | 207.7 | 55.6 | 275 | 265.6 | 71.2 |
| 36 | 34.8 | 09.3 | 96 | 92.7 | 24.8 | 156 | 150.7 | 40.4 | 216 | 208.6 | 55.9 | 276 | 266.6 | 71.4 |
| 37 | 35.7 | 09.6 | 97 | 93.7 | 25.1 | 157 | 151.7 | 40.6 | 217 | 209.6 | 56.2 | 277 | 267.6 | 71.7 |
| 38 | 36.7 | 09.8 | 98 | 94.7 | 25.4 | 158 | 152.6 | 40.9 | 218 | 210.6 | 56.4 | 278 | 268.5 | 72.0 |
| 39 | 37.7 | 10.1 | 99 | 95.6 | 25.6 | 159 | 153.6 | 41.2 | 219 | 211.5 | 56.7 | 279 | 269.5 | 72.2 |
| 40 | 38.6 | 10.4 | 100 | 96.6 | 25.9 | 160 | 154.5 | 41.4 | 220 | 212.5 | 56.9 | 280 | 270.5 | 72.5 |
| 41 | 39.6 | 10.6 | 101 | 97.6 | 26.1 | 161 | 155.5 | 41.7 | 221 | 213.5 | 57.2 | 281 | 271.4 | 72.7 |
| 42 | 40.6 | 10.9 | 102 | 98.5 | 26.4 | 162 | 156.5 | 41.9 | 222 | 214.4 | 57.5 | 282 | 272.4 | 73.0 |
| 43 | 41.5 | 11.1 | 103 | 99.5 | 26.7 | 163 | 157.4 | 42.2 | 223 | 215.4 | 57.7 | 283 | 273.4 | 73.2 |
| 44 | 42.5 | 11.4 | 104 | 100.5 | 26.9 | 164 | 158.4 | 42.4 | 224 | 216.4 | 58.0 | 284 | 274.3 | 73.5 |
| 45 | 43.5 | 11.6 | 105 | 101.4 | 27.2 | 165 | 159.4 | 42.7 | 225 | 217.3 | 58.2 | 285 | 275.3 | 73.8 |
| 46 | 44.4 | 11.9 | 106 | 102.4 | 27.4 | 166 | 160.3 | 43.0 | 226 | 218.3 | 58.5 | 286 | 276.3 | 74.0 |
| 47 | 45.4 | 12.2 | 107 | 103.4 | 27.7 | 167 | 161.3 | 43.2 | 227 | 219.3 | 58.8 | 287 | 277.2 | 74.3 |
| 48 | 46.4 | 12.4 | 108 | 104.3 | 28.0 | 168 | 162.3 | 43.5 | 228 | 220.2 | 59.0 | 288 | 278.2 | 74.5 |
| 49 | 47.3 | 12.7 | 109 | 105.3 | 28.2 | 169 | 163.2 | 43.7 | 229 | 221.2 | 59.3 | 289 | 279.2 | 74.8 |
| 50 | 48.3 | 12.9 | 110 | 106.3 | 28.5 | 170 | 164.2 | 44.0 | 230 | 222.2 | 59.5 | 290 | 280.1 | 75.1 |
| 51 | 49.3 | 13.2 | 111 | 107.2 | 28.7 | 171 | 165.2 | 44.3 | 231 | 223.1 | 59.8 | 291 | 281.1 | 75.3 |
| 52 | 50.2 | 13.5 | 112 | 108.2 | 29.0 | 172 | 166.1 | 44.5 | 232 | 224.1 | 60.0 | 292 | 282.1 | 75.6 |
| 53 | 51.2 | 13.7 | 113 | 109.1 | 29.2 | 173 | 167.1 | 44.8 | 233 | 225.1 | 60.3 | 293 | 283.0 | 75.8 |
| 54 | 52.2 | 14.0 | 114 | 110.1 | 29.5 | 174 | 168.1 | 45.0 | 234 | 226.0 | 60.6 | 294 | 284.0 | 76.1 |
| 55 | 53.1 | 14.2 | 115 | 111.1 | 29.8 | 175 | 169.0 | 45.3 | 235 | 227.0 | 60.8 | 295 | 284.9 | 76.4 |
| 56 | 54.1 | 14.5 | 116 | 112.0 | 30.0 | 176 | 170.0 | 45.6 | 236 | 228.0 | 61.1 | 296 | 285.9 | 76.6 |
| 57 | 55.1 | 14.8 | 117 | 113.0 | 30.3 | 177 | 171.0 | 45.8 | 237 | 228.9 | 61.3 | 297 | 286.9 | 76.9 |
| 58 | 56.0 | 15.0 | 118 | 114.0 | 30.5 | 178 | 171.9 | 46.1 | 238 | 229.9 | 61.6 | 298 | 287.8 | 77.1 |
| 59 | 57.0 | 15.3 | 119 | 114.9 | 30.8 | 179 | 172.9 | 46.3 | 239 | 230.9 | 61.9 | 299 | 288.8 | 77.4 |
| 60 | 58.0 | 15.5 | 120 | 115.9 | 31.1 | 180 | 173.9 | 46.6 | 240 | 231.8 | 62.1 | 300 | 289.8 | 77.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 75 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 14 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.2 | 61 | 59.2 | 14.8 | 121 | 117.4 | 29.3 | 181 | 175.6 | 43.8 | 241 | 233.8 | 58.3 |
| 2 | 01.9 | 00.5 | 62 | 60.2 | 15.0 | 122 | 118.4 | 29.5 | 182 | 176.6 | 44.0 | 242 | 234.8 | 58.5 |
| 3 | 02.9 | 00.7 | 63 | 61.1 | 15.2 | 123 | 119.3 | 29.8 | 183 | 177.6 | 44.3 | 243 | 235.8 | 58.8 |
| 4 | 03.9 | 01.0 | 64 | 62.1 | 15.5 | 124 | 120.3 | 30.0 | 184 | 178.5 | 44.5 | 244 | 236.8 | 59.0 |
| 5 | 04.9 | 01.2 | 65 | 63.1 | 15.7 | 125 | 121.3 | 30.2 | 185 | 179.5 | 44.8 | 245 | 237.7 | 59.3 |
| 6 | 05.8 | 01.5 | 66 | 64.0 | 16.0 | 126 | 122.3 | 30.5 | 186 | 180.5 | 45.0 | 246 | 238.7 | 59.5 |
| 7 | 06.8 | 01.7 | 67 | 65.0 | 16.2 | 127 | 123.2 | 30.7 | 187 | 181.4 | 45.2 | 247 | 239.7 | 59.8 |
| 8 | 07.8 | 01.9 | 68 | 66.0 | 16.5 | 128 | 124.2 | 31.0 | 188 | 182.4 | 45.5 | 248 | 240.6 | 60.0 |
| 9 | 08.7 | 02.2 | 69 | 67.0 | 16.7 | 129 | 125.2 | 31.2 | 189 | 183.4 | 45.7 | 249 | 241.6 | 60.2 |
| 10 | 09.7 | 02.4 | 70 | 67.9 | 16.9 | 130 | 126.1 | 31.4 | 190 | 184.4 | 46.0 | 250 | 242.6 | 60.5 |
| 11 | 10.7 | 02.7 | 71 | 68.9 | 17.2 | 131 | 127.1 | 31.7 | 191 | 185.3 | 46.2 | 251 | 243.5 | 60.7 |
| 12 | 11.6 | 02.9 | 72 | 69.9 | 17.4 | 132 | 128.1 | 31.9 | 192 | 186.3 | 46.4 | 252 | 244.5 | 61.0 |
| 13 | 12.6 | 03.1 | 73 | 70.8 | 17.7 | 133 | 129.0 | 32.2 | 193 | 187.3 | 46.7 | 253 | 245.5 | 61.2 |
| 14 | 13.6 | 03.4 | 74 | 71.8 | 17.9 | 134 | 130.0 | 32.4 | 194 | 188.2 | 46.9 | 254 | 246.5 | 61.4 |
| 15 | 14.6 | 03.6 | 75 | 72.8 | 18.1 | 135 | 131.0 | 32.7 | 195 | 189.2 | 47.2 | 255 | 247.4 | 61.7 |
| 16 | 15.5 | 03.9 | 76 | 73.7 | 18.4 | 136 | 132.0 | 32.9 | 196 | 190.2 | 47.4 | 256 | 248.4 | 61.9 |
| 17 | 16.5 | 04.1 | 77 | 74.7 | 18.6 | 137 | 132.9 | 33.1 | 197 | 191.1 | 47.7 | 257 | 249.4 | 62.2 |
| 18 | 17.5 | 04.4 | 78 | 75.7 | 18.9 | 138 | 133.9 | 33.4 | 198 | 192.1 | 47.9 | 258 | 250.3 | 62.4 |
| 19 | 18.4 | 04.6 | 79 | 76.7 | 19.1 | 139 | 134.9 | 33.6 | 199 | 193.1 | 48.1 | 259 | 251.3 | 62.7 |
| 20 | 19.4 | 04.8 | 80 | 77.6 | 19.4 | 140 | 135.8 | 33.9 | 200 | 194.1 | 48.4 | 260 | 252.3 | 62.9 |
| 21 | 20.4 | 05.1 | 81 | 78.6 | 19.6 | 141 | 136.8 | 34.1 | 201 | 195.0 | 48.6 | 261 | 253.2 | 63.1 |
| 22 | 21.3 | 05.3 | 82 | 79.6 | 19.8 | 142 | 137.8 | 34.4 | 202 | 196.0 | 48.9 | 262 | 254.2 | 63.4 |
| 23 | 22.3 | 05.6 | 83 | 80.5 | 20.1 | 143 | 138.8 | 34.6 | 203 | 197.0 | 49.1 | 263 | 255.2 | 63.6 |
| 24 | 23.3 | 05.8 | 84 | 81.5 | 20.3 | 144 | 139.7 | 34.8 | 204 | 197.9 | 49.4 | 264 | 256.2 | 63.9 |
| 25 | 24.3 | 06.0 | 85 | 82.5 | 20.6 | 145 | 140.7 | 35.1 | 205 | 198.9 | 49.6 | 265 | 257.1 | 64.1 |
| 26 | 25.2 | 06.3 | 86 | 83.4 | 20.8 | 146 | 141.7 | 35.3 | 206 | 199.9 | 49.8 | 266 | 258.1 | 64.4 |
| 27 | 26.2 | 06.5 | 87 | 84.4 | 21.0 | 147 | 142.6 | 35.6 | 207 | 200.9 | 50.1 | 267 | 259.1 | 64.6 |
| 28 | 27.2 | 06.8 | 88 | 85.4 | 21.3 | 148 | 143.6 | 35.8 | 208 | 201.8 | 50.3 | 268 | 260.0 | 64.8 |
| 29 | 28.1 | 07.0 | 89 | 86.4 | 21.5 | 149 | 144.6 | 36.0 | 209 | 202.8 | 50.6 | 269 | 261.0 | 65.1 |
| 30 | 29.1 | 07.3 | 90 | 87.3 | 21.8 | 150 | 145.5 | 36.3 | 210 | 203.8 | 50.8 | 270 | 262.0 | 65.3 |
| 31 | 30.1 | 07.5 | 91 | 88.3 | 22.0 | 151 | 146.5 | 36.5 | 211 | 204.7 | 51.0 | 271 | 263.0 | 65.6 |
| 32 | 31.0 | 07.7 | 92 | 89.3 | 22.3 | 152 | 147.5 | 36.8 | 212 | 205.7 | 51.3 | 272 | 263.9 | 65.8 |
| 33 | 32.0 | 08.0 | 93 | 90.2 | 22.5 | 153 | 148.5 | 37.0 | 213 | 206.7 | 51.5 | 273 | 264.9 | 66.0 |
| 34 | 33.0 | 08.2 | 94 | 91.2 | 22.7 | 154 | 149.4 | 37.3 | 214 | 207.6 | 51.8 | 274 | 265.9 | 66.3 |
| 35 | 34.0 | 08.5 | 95 | 92.2 | 23.0 | 155 | 150.4 | 37.5 | 215 | 208.6 | 52.0 | 275 | 266.8 | 66.5 |
| 36 | 34.9 | 08.7 | 96 | 93.1 | 23.2 | 156 | 151.4 | 37.7 | 216 | 209.6 | 52.3 | 276 | 267.8 | 66.8 |
| 37 | 35.9 | 09.0 | 97 | 94.1 | 23.5 | 157 | 152.3 | 38.0 | 217 | 210.6 | 52.5 | 277 | 268.8 | 67.0 |
| 38 | 36.9 | 09.2 | 98 | 95.1 | 23.7 | 158 | 153.3 | 38.2 | 218 | 211.5 | 52.7 | 278 | 269.7 | 67.3 |
| 39 | 37.8 | 09.4 | 99 | 96.1 | 24.0 | 159 | 154.3 | 38.5 | 219 | 212.5 | 53.0 | 279 | 270.7 | 67.5 |
| 40 | 38.8 | 09.7 | 100 | 97.0 | 24.2 | 160 | 155.2 | 38.7 | 220 | 213.5 | 53.2 | 280 | 271.7 | 67.7 |
| 41 | 39.8 | 09.9 | 101 | 98.0 | 24.4 | 161 | 156.2 | 38.9 | 221 | 214.4 | 53.5 | 281 | 272.7 | 68.0 |
| 42 | 40.8 | 10.2 | 102 | 99.0 | 24.7 | 162 | 157.2 | 39.2 | 222 | 215.4 | 53.7 | 282 | 273.6 | 68.2 |
| 43 | 41.7 | 10.4 | 103 | 99.9 | 24.9 | 163 | 158.2 | 39.4 | 223 | 216.4 | 53.9 | 283 | 274.6 | 68.5 |
| 44 | 42.7 | 10.6 | 104 | 100.9 | 25.2 | 164 | 159.1 | 39.7 | 224 | 217.3 | 54.2 | 284 | 275.6 | 68.7 |
| 45 | 43.7 | 10.9 | 105 | 101.9 | 25.4 | 165 | 160.1 | 39.9 | 225 | 218.3 | 54.4 | 285 | 276.5 | 68.9 |
| 46 | 44.6 | 11.1 | 106 | 102.9 | 25.6 | 166 | 161.1 | 40.2 | 226 | 219.3 | 54.7 | 286 | 277.5 | 69.2 |
| 47 | 45.6 | 11.4 | 107 | 103.8 | 25.9 | 167 | 162.0 | 40.4 | 227 | 220.3 | 54.9 | 287 | 278.5 | 69.4 |
| 48 | 46.6 | 11.6 | 108 | 104.8 | 26.1 | 168 | 163.0 | 40.6 | 228 | 221.2 | 55.2 | 288 | 279.4 | 69.7 |
| 49 | 47.5 | 11.9 | 109 | 105.8 | 26.4 | 169 | 164.0 | 40.9 | 229 | 222.2 | 55.4 | 289 | 280.4 | 69.9 |
| 50 | 48.5 | 12.1 | 110 | 106.7 | 26.6 | 170 | 165.0 | 41.1 | 230 | 223.2 | 55.6 | 290 | 281.4 | 70.2 |
| 51 | 49.5 | 12.3 | 111 | 107.7 | 26.9 | 171 | 165.9 | 41.4 | 231 | 224.1 | 55.9 | 291 | 282.4 | 70.4 |
| 52 | 50.5 | 12.6 | 112 | 108.7 | 27.1 | 172 | 166.9 | 41.6 | 232 | 225.1 | 56.1 | 292 | 283.3 | 70.6 |
| 53 | 51.4 | 12.8 | 113 | 109.6 | 27.3 | 173 | 167.9 | 41.9 | 233 | 226.1 | 56.4 | 293 | 284.3 | 70.9 |
| 54 | 52.4 | 13.1 | 114 | 110.6 | 27.6 | 174 | 168.8 | 42.1 | 234 | 227.0 | 56.6 | 294 | 285.3 | 71.1 |
| 55 | 53.4 | 13.3 | 115 | 111.6 | 27.8 | 175 | 169.8 | 42.3 | 235 | 228.0 | 56.9 | 295 | 286.2 | 71.4 |
| 56 | 54.3 | 13.5 | 116 | 112.6 | 28.1 | 176 | 170.8 | 42.6 | 236 | 229.0 | 57.1 | 296 | 287.2 | 71.6 |
| 57 | 55.3 | 13.8 | 117 | 113.5 | 28.3 | 177 | 171.7 | 42.8 | 237 | 230.0 | 57.3 | 297 | 288.2 | 71.9 |
| 58 | 56.3 | 14.0 | 118 | 114.5 | 28.6 | 178 | 172.7 | 43.1 | 238 | 230.9 | 57.6 | 298 | 289.1 | 72.1 |
| 59 | 57.2 | 14.3 | 119 | 115.5 | 28.8 | 179 | 173.7 | 43.3 | 239 | 231.9 | 57.8 | 299 | 290.1 | 72.3 |
| 60 | 58.2 | 14.5 | 120 | 116.4 | 29.0 | 180 | 174.7 | 43.5 | 240 | 232.9 | 58.1 | 300 | 291.1 | 72.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 76 Degrees.

## Difference of Latitude and Departure for 15 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.3 | 61 | 58.9 | 15.8 | 121 | 116.9 | 31.3 | 181 | 174.8 | 46.8 | 241 | 232.8 | 62.4 |
| 2 | 01.9 | 00.5 | 62 | 59.9 | 16.0 | 122 | 117.8 | 31.6 | 182 | 175.8 | 47.1 | 242 | 233.8 | 62.6 |
| 3 | 02.9 | 00.8 | 63 | 60.9 | 16.3 | 123 | 118.8 | 31.8 | 183 | 176.8 | 47.4 | 243 | 234.7 | 62.9 |
| 4 | 03.9 | 01.0 | 64 | 61.8 | 16.6 | 124 | 119.8 | 32.1 | 184 | 177.7 | 47.6 | 244 | 235.7 | 63.2 |
| 5 | 04.8 | 01.3 | 65 | 62.8 | 16.8 | 125 | 120.7 | 32.4 | 185 | 178.7 | 47.9 | 245 | 236.7 | 63.4 |
| 6 | 05.8 | 01.6 | 66 | 63.8 | 17.1 | 126 | 121.7 | 32.6 | 186 | 179.7 | 48.1 | 246 | 237.6 | 63.7 |
| 7 | 06.8 | 01.8 | 67 | 64.7 | 17.3 | 127 | 122.7 | 32.9 | 187 | 180.6 | 48.4 | 247 | 238.6 | 63.9 |
| 8 | 07.7 | 02.1 | 68 | 65.7 | 17.6 | 128 | 123.6 | 33.1 | 188 | 181.6 | 48.7 | 248 | 239.5 | 64.2 |
| 9 | 08.7 | 02.3 | 69 | 66.6 | 17.9 | 129 | 124.6 | 33.4 | 189 | 182.6 | 48.9 | 249 | 240.5 | 64.4 |
| 10 | 09.7 | 02.6 | 70 | 67.6 | 18.1 | 130 | 125.6 | 33.6 | 190 | 183.5 | 49.2 | 250 | 241.5 | 64.7 |
| 11 | 10.6 | 02.8 | 71 | 68.6 | 18.4 | 131 | 126.5 | 33.9 | 191 | 184.5 | 49.4 | 251 | 242.4 | 65.0 |
| 12 | 11.6 | 03.1 | 72 | 69.5 | 18.6 | 132 | 127.5 | 34.2 | 192 | 185.5 | 49.7 | 252 | 243.4 | 65.2 |
| 13 | 12.6 | 03.4 | 73 | 70.5 | 18.9 | 133 | 128.5 | 34.4 | 193 | 186.4 | 50.0 | 253 | 244.4 | 65.5 |
| 14 | 13.5 | 03.6 | 74 | 71.5 | 19.2 | 134 | 129.4 | 34.7 | 194 | 187.4 | 50.2 | 254 | 245.3 | 65.7 |
| 15 | 14.5 | 03.9 | 75 | 72.4 | 19.4 | 135 | 130.4 | 34.9 | 195 | 188.4 | 50.5 | 255 | 246.3 | 66.0 |
| 16 | 15.5 | 04.1 | 76 | 73.4 | 19.7 | 136 | 131.4 | 35.2 | 196 | 189.3 | 50.7 | 256 | 247.3 | 66.3 |
| 17 | 16.4 | 04.4 | 77 | 74.4 | 19.9 | 137 | 132.3 | 35.5 | 197 | 190.3 | 51.0 | 257 | 248.2 | 66.5 |
| 18 | 17.4 | 04.7 | 78 | 75.3 | 20.2 | 138 | 133.3 | 35.7 | 198 | 191.3 | 51.2 | 258 | 249.2 | 66.8 |
| 19 | 18.4 | 04.9 | 79 | 76.3 | 20.4 | 139 | 134.3 | 36.0 | 199 | 192.2 | 51.5 | 259 | 250.2 | 67.0 |
| 20 | 19 3 | 05.2 | 80 | 77.3 | 20.7 | 140 | 135.2 | 36.2 | 200 | 193.2 | 51.8 | 260 | 251.1 | 67.3 |
| 21 | 20.3 | 05.4 | 81 | 78.2 | 21.0 | 141 | 136.2 | 36.5 | 201 | 194.2 | 52.0 | 261 | 252.1 | 67.6 |
| 22 | 21.3 | 05.7 | 82 | 79.2 | 21.2 | 142 | 137.2 | 36.8 | 202 | 195.1 | 52.3 | 262 | 253.1 | 67.8 |
| 23 | 22.2 | 06.0 | 83 | 80.2 | 21 5 | 143 | 138·1 | 37.0 | 203 | 196.1 | 52.5 | 263 | 254.0 | 68.1 |
| 24 | 23.2 | 06.2 | 84 | 81.1 | 21.7 | 144 | 139.1 | 37.3 | 204 | 197.0 | 52.8 | 264 | 255.0 | 68.3 |
| 25 | 24.1 | 06.5 | 85 | 82.1 | 22.0 | 145 | 140.1 | 37.5 | 205 | 198.0 | 53.1 | 265 | 256.0 | 68.6 |
| 26 | 25.1 | 06.7 | 86 | 83.1 | 22.3 | 146 | 141.0 | 37.8 | 206 | 199.0 | 53.3 | 266 | 256.9 | 68.8 |
| 27 | 26.1 | 07.0 | 87 | 84.0 | 22.5 | 147 | 142.0 | 38.0 | 207 | 199.9 | 53.6 | 267 | 257.9 | 69.1 |
| 28 | 27.0 | 07.2 | 88 | 85.0 | 22.8 | 148 | 143.0 | 38.3 | 208 | 200.9 | 53.8 | 268 | 258.9 | 69.4 |
| 29 | 28.0 | 07.5 | 89 | 86.0 | 23.0 | 149 | 143.9 | 38.6 | 209 | 201.9 | 54.1 | 269 | 259.8 | 69.6 |
| 30 | 29.0 | 07.8 | 90 | 86.9 | 23.3 | 150 | 144.9 | 38.8 | 210 | 202.8 | 54.4 | 270 | 260.8 | 69.9 |
| 31 | 29.9 | 08.0 | 91 | 87.9 | 23.6 | 151 | 145.9 | 39.1 | 211 | 203.8 | 54.6 | 271 | 261.8 | 70.1 |
| 32 | 30.9 | 08.3 | 92 | 88.9 | 23.8 | 152 | 146.8 | 39.3 | 212 | 204.8 | 54.9 | 272 | 262.7 | 70.4 |
| 33 | 31.9 | 08.5 | 93 | 89.8 | 24.1 | 153 | 147.8 | 39.6 | 213 | 205.7 | 55.1 | 273 | 263.7 | 70.7 |
| 34 | 32.8 | 08.8 | 94 | 90.8 | 24.3 | 154 | 148.8 | 39.9 | 214 | 206.7 | 55.4 | 274 | 264.7 | 70.9 |
| 35 | 33.8 | 09.1 | 95 | 91.8 | 24.6 | 155 | 149.7 | 40.1 | 215 | 207.7 | 55.6 | 275 | 265.6 | 71.2 |
| 36 | 34.8 | 09.3 | 96 | 92.7 | 24.8 | 156 | 150.7 | 40.4 | 216 | 208.6 | 55.9 | 276 | 266.6 | 71.4 |
| 37 | 35.7 | 09.6 | 97 | 93.7 | 25.1 | 157 | 151.7 | 40.6 | 217 | 209.6 | 56.2 | 277 | 267.6 | 71.7 |
| 38 | 36.7 | 09.8 | 98 | 94.7 | 25.4 | 158 | 152.6 | 40.9 | 218 | 210.6 | 56.4 | 278 | 268.5 | 72.0 |
| 39 | 37.7 | 10.1 | 99 | 95.6 | 25.6 | 159 | 153.6 | 41.2 | 219 | 211.5 | 56.7 | 279 | 269.5 | 72.2 |
| 40 | 38.6 | 10.4 | 100 | 96.6 | 25.9 | 160 | 154.5 | 41.4 | 220 | 212.5 | 56.9 | 280 | 270.5 | 72.5 |
| 41 | 39.6 | 10.6 | 101 | 97.6 | 26.1 | 161 | 155.5 | 41.7 | 221 | 213.5 | 57.2 | 281 | 271.4 | 72.7 |
| 42 | 40.6 | 10.9 | 102 | 98.5 | 26.4 | 162 | 156.5 | 41.9 | 222 | 214.4 | 57.5 | 282 | 272.4 | 73.0 |
| 43 | 41.5 | 11.1 | 103 | 99.5 | 26.7 | 163 | 157.4 | 42.2 | 223 | 215.4 | 57.7 | 283 | 273.4 | 73.2 |
| 44 | 42.5 | 11.4 | 104 | 100.5 | 26.9 | 164 | 158.4 | 42.4 | 224 | 216.4 | 58.0 | 284 | 274.3 | 73.5 |
| 45 | 43.5 | 11.6 | 105 | 101.4 | 27.2 | 165 | 159.4 | 42.7 | 225 | 217.3 | 58.2 | 285 | 275.3 | 73.8 |
| 46 | 44.4 | 11.9 | 106 | 102.4 | 27.4 | 166 | 160.3 | 43.0 | 226 | 218.3 | 58.5 | 286 | 276.3 | 74.0 |
| 47 | 45.4 | 12.2 | 107 | 103.4 | 27.7 | 167 | 161.3 | 43.2 | 227 | 219.3 | 58.8 | 287 | 277.2 | 74.3 |
| 48 | 46.4 | 12.4 | 108 | 104.3 | 28.0 | 168 | 162.3 | 43.5 | 228 | 220.2 | 59.0 | 288 | 278.2 | 74.5 |
| 49 | 47.3 | 12.7 | 109 | 105.3 | 28.2 | 169 | 163.2 | 43.7 | 229 | 221.2 | 59.3 | 289 | 279.2 | 74.8 |
| 50 | 48.3 | 12.9 | 110 | 106.3 | 28.5 | 170 | 164.2 | 44.0 | 230 | 222.2 | 59.5 | 290 | 280.1 | 75.1 |
| 51 | 49.3 | 13.2 | 111 | 107.2 | 28.7 | 171 | 165.2 | 44.3 | 231 | 223.1 | 59.8 | 291 | 281.1 | 75.3 |
| 52 | 50.2 | 13.5 | 112 | 108.2 | 29.0 | 172 | 166.1 | 44.5 | 232 | 224.1 | 60.0 | 292 | 282.1 | 75.6 |
| 53 | 51.2 | 13.7 | 113 | 109.1 | 29.2 | 173 | 167.1 | 44.8 | 233 | 225.1 | 60.3 | 293 | 283.0 | 75.8 |
| 54 | 52.2 | 14.0 | 114 | 110.1 | 29.5 | 174 | 168.1 | 45.0 | 234 | 226.0 | 60.6 | 294 | 284.0 | 76.1 |
| 55 | 53.1 | 14.2 | 115 | 111.1 | 29.8 | 175 | 169.0 | 45.3 | 235 | 227.0 | 60.8 | 295 | 284.9 | 76.4 |
| 56 | 54.1 | 14.5 | 116 | 112.0 | 30.0 | 176 | 170.0 | 45.6 | 236 | 228.0 | 61.1 | 296 | 285.9 | 76.6 |
| 57 | 55.1 | 14.8 | 117 | 113.0 | 30.3 | 177 | 171.0 | 45.8 | 237 | 228.9 | 61.3 | 297 | 286.9 | 76.9 |
| 58 | 56.0 | 15.0 | 118 | 114.0 | 30.5 | 178 | 171.9 | 46.1 | 238 | 229.9 | 61.6 | 298 | 287.8 | 77.1 |
| 59 | 57.0 | 15.3 | 119 | 114.9 | 30.8 | 179 | 172.9 | 46.3 | 239 | 230.9 | 61.9 | 299 | 288.8 | 77.4 |
| 60 | 58.0 | 15.5 | 120 | 115.9 | 31.1 | 180 | 173.9 | 46.6 | 240 | 231.8 | 62.1 | 300 | 289.8 | 77.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 75 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 16 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.3 | 61 | 58.6 | 16.8 | 121 | 116.3 | 33.4 | 181 | 174.0 | 49.9 | 241 | 231.7 | 66.4 |
| 2 | 01.9 | 00.6 | 62 | 59.6 | 17.1 | 122 | 117.3 | 33.6 | 182 | 174.9 | 50.2 | 242 | 232.6 | 66.7 |
| 3 | 02.9 | 00.8 | 63 | 60.6 | 17.4 | 123 | 118.2 | 33.9 | 183 | 175.9 | 50.4 | 243 | 233.6 | 67.0 |
| 4 | 03.8 | 01.1 | 64 | 61.5 | 17.6 | 124 | 119.2 | 34.2 | 184 | 176.9 | 50.7 | 244 | 234.5 | 67.3 |
| 5 | 04.8 | 01.4 | 65 | 62.5 | 17.9 | 125 | 120.2 | 34.5 | 185 | 177.8 | 51.0 | 245 | 235.5 | 67.5 |
| 6 | 05.8 | 01.7 | 66 | 63.4 | 18.2 | 126 | 121.1 | 34.7 | 186 | 178.8 | 51.3 | 246 | 236.5 | 67.8 |
| 7 | 06.7 | 01.9 | 67 | 64.4 | 18.5 | 127 | 122.1 | 35.0 | 187 | 179.8 | 51.5 | 247 | 237.4 | 68.1 |
| 8 | 07.7 | 02.2 | 68 | 65.4 | 18.7 | 128 | 123.0 | 35.3 | 188 | 180.7 | 51.8 | 248 | 238.4 | 68.4 |
| 9 | 08.7 | 02.5 | 69 | 66.3 | 19.0 | 129 | 124.0 | 35.6 | 189 | 181.7 | 52.1 | 249 | 239.4 | 68.6 |
| 10 | 09.6 | 02.8 | 70 | 67.3 | 19.3 | 130 | 125.0 | 35.8 | 190 | 182.6 | 52.4 | 250 | 240.3 | 68.9 |
| 11 | 10.6 | 03.0 | 71 | 68.2 | 19.6 | 131 | 125.9 | 36.1 | 191 | 183.6 | 52.6 | 251 | 241.3 | 69.2 |
| 12 | 11.5 | 03.3 | 72 | 69.2 | 19.8 | 132 | 126.9 | 36.4 | 192 | 184.6 | 52.9 | 252 | 242.2 | 69.5 |
| 13 | 12.5 | 03.6 | 73 | 70.2 | 20.1 | 133 | 127.8 | 36.7 | 193 | 185.5 | 53.2 | 253 | 243.2 | 69.7 |
| 14 | 13.5 | 03.9 | 74 | 71.1 | 20.4 | 134 | 128.8 | 36.9 | 194 | 186.5 | 53.5 | 254 | 244.2 | 70.0 |
| 15 | 14.4 | 04.1 | 75 | 72.1 | 20.7 | 135 | 129.8 | 37.2 | 195 | 187.4 | 53.7 | 255 | 245.1 | 70.3 |
| 16 | 15.4 | 04.4 | 76 | 73.1 | 20.9 | 136 | 130.7 | 37.5 | 196 | 188.4 | 54.0 | 256 | 246.1 | 70.6 |
| 17 | 16.3 | 04.7 | 77 | 74.0 | 21.2 | 137 | 131.7 | 37.8 | 197 | 189.4 | 54.3 | 257 | 247.0 | 70.8 |
| 18 | 17.3 | 05.0 | 78 | 75.0 | 21.5 | 138 | 132.7 | 38.0 | 198 | 190.3 | 54.6 | 258 | 248.0 | 71.1 |
| 19 | 18.3 | 05.2 | 79 | 75.9 | 21.8 | 139 | 133.6 | 38.3 | 199 | 191.3 | 54.9 | 259 | 249.0 | 71.4 |
| 20 | 19.2 | 05.5 | 80 | 76.9 | 22.1 | 140 | 134.6 | 38.6 | 200 | 192.3 | 55.1 | 260 | 249.9 | 71.7 |
| 21 | 20.2 | 05.8 | 81 | 77.9 | 22.3 | 141 | 135.5 | 38.9 | 201 | 193.2 | 55.4 | 261 | 250.9 | 71.9 |
| 22 | 21.1 | 06.1 | 82 | 78.8 | 22.6 | 142 | 136.5 | 39.1 | 202 | 194.2 | 55.7 | 262 | 251.9 | 72.2 |
| 23 | 22.1 | 06.3 | 83 | 79.8 | 22.9 | 143 | 137.5 | 39.4 | 203 | 195.1 | 56.0 | 263 | 252.8 | 72.5 |
| 24 | 23.1 | 06.6 | 84 | 80.7 | 23.2 | 144 | 138.4 | 39.7 | 204 | 196.1 | 56.2 | 264 | 253.8 | 72.8 |
| 25 | 24.0 | 06.9 | 85 | 81.7 | 23.4 | 145 | 139.4 | 40.0 | 205 | 197.1 | 56.5 | 265 | 254.7 | 73.0 |
| 26 | 25.0 | 07.2 | 86 | 82.7 | 23.7 | 146 | 140.3 | 40.2 | 206 | 198.0 | 56.8 | 266 | 255.7 | 73.3 |
| 27 | 26.0 | 07.4 | 87 | 83.6 | 24.0 | 147 | 141.3 | 40.5 | 207 | 199.0 | 57.1 | 267 | 256.7 | 73.6 |
| 28 | 26.9 | 07.7 | 88 | 84.6 | 24.3 | 148 | 142.3 | 40.8 | 208 | 199.9 | 57.3 | 268 | 257.6 | 73.9 |
| 29 | 27.9 | 08.0 | 89 | 85.6 | 24.5 | 149 | 143.2 | 41.1 | 209 | 200.9 | 57.6 | 269 | 258.6 | 74.1 |
| 30 | 28.8 | 08.3 | 90 | 86.5 | 24.8 | 150 | 144.2 | 41.3 | 210 | 201.9 | 57.9 | 270 | 259.5 | 74.4 |
| 31 | 29.8 | 08.5 | 91 | 87.5 | 25.1 | 151 | 145.2 | 41.6 | 211 | 202.8 | 58.2 | 271 | 260.5 | 74.7 |
| 32 | 30.8 | 08.8 | 92 | 88.4 | 25.4 | 152 | 146.1 | 41.9 | 212 | 203.8 | 58.4 | 272 | 261.5 | 75.0 |
| 33 | 31.7 | 09.1 | 93 | 89.4 | 25.6 | 153 | 147.1 | 42.2 | 213 | 204.7 | 58.7 | 273 | 262.4 | 75.2 |
| 34 | 32.7 | 09.4 | 94 | 90.4 | 25.9 | 154 | 148.0 | 42.4 | 214 | 205.7 | 59.0 | 274 | 263.4 | 75.5 |
| 35 | 33.6 | 09.6 | 95 | 91.3 | 26.2 | 155 | 149.0 | 42.7 | 215 | 206.7 | 59.3 | 275 | 264.3 | 75.8 |
| 36 | 34.6 | 09.9 | 96 | 92.3 | 26.5 | 156 | 150.0 | 43.0 | 216 | 207.6 | 59.5 | 276 | 265.3 | 76.1 |
| 37 | 35.6 | 10.2 | 97 | 93.2 | 26.7 | 157 | 150.9 | 43.3 | 217 | 208.6 | 59.8 | 277 | 266.3 | 76.4 |
| 38 | 36.5 | 10.5 | 98 | 94.2 | 27.0 | 158 | 151.9 | 43.6 | 218 | 209.6 | 60.1 | 278 | 267.2 | 76.6 |
| 39 | 37.5 | 10.7 | 99 | 95.2 | 27.3 | 159 | 152.8 | 43.8 | 219 | 210.5 | 60.4 | 279 | 268.2 | 76.9 |
| 40 | 38.5 | 11.0 | 100 | 96.1 | 27.6 | 160 | 153.8 | 44.1 | 220 | 211.5 | 60.6 | 280 | 269.2 | 77.2 |
| 41 | 39.4 | 11.3 | 101 | 97.1 | 27.8 | 161 | 154.8 | 44.4 | 221 | 212.4 | 60.9 | 281 | 270.1 | 77.5 |
| 42 | 40.4 | 11.6 | 102 | 98.0 | 28.1 | 162 | 155.7 | 44.7 | 222 | 213.4 | 61.2 | 282 | 271.1 | 77.7 |
| 43 | 41.3 | 11.9 | 103 | 99.0 | 28.4 | 163 | 156.7 | 44.9 | 223 | 214.4 | 61.5 | 283 | 272.0 | 78.0 |
| 44 | 42.3 | 12.1 | 104 | 100.0 | 28.7 | 164 | 157.6 | 45.2 | 224 | 215.3 | 61.7 | 284 | 273.0 | 78.3 |
| 45 | 43.3 | 12.4 | 105 | 100.9 | 28.9 | 165 | 158.6 | 45.5 | 225 | 216.3 | 62.0 | 285 | 274.0 | 78.6 |
| 46 | 44.2 | 12.7 | 106 | 101.9 | 29.2 | 166 | 159.6 | 45.8 | 226 | 217.2 | 62.3 | 286 | 274.9 | 78.8 |
| 47 | 45.2 | 13.0 | 107 | 102.9 | 29.5 | 167 | 160.5 | 46.0 | 227 | 218.2 | 62.6 | 287 | 275.9 | 79.1 |
| 48 | 46.1 | 13.2 | 108 | 103.8 | 29.8 | 168 | 161.5 | 46.3 | 228 | 219.2 | 62.8 | 288 | 276.8 | 79.4 |
| 49 | 47.1 | 13.5 | 109 | 104.8 | 30.0 | 169 | 162.5 | 46.6 | 229 | 220.1 | 63.1 | 289 | 277.8 | 79.7 |
| 50 | 48.1 | 13.8 | 110 | 105.7 | 30.3 | 170 | 163.4 | 46.9 | 230 | 221.1 | 63.4 | 290 | 278.8 | 79.9 |
| 51 | 49.0 | 14.1 | 111 | 106.7 | 30.6 | 171 | 164.4 | 47.1 | 231 | 222.1 | 63.7 | 291 | 279.7 | 80.2 |
| 52 | 50.0 | 14.3 | 112 | 107.7 | 30.9 | 172 | 165.3 | 47.4 | 232 | 223.0 | 63.9 | 292 | 280.7 | 80.5 |
| 53 | 50.9 | 14.6 | 113 | 108.6 | 31.1 | 173 | 166.3 | 47.7 | 233 | 224.0 | 64.2 | 293 | 281.6 | 80.8 |
| 54 | 51.9 | 14.9 | 114 | 109.6 | 31.4 | 174 | 167.3 | 48.0 | 234 | 224.9 | 64.5 | 294 | 282.6 | 81.0 |
| 55 | 52.9 | 15.2 | 115 | 110.5 | 31.7 | 175 | 168.2 | 48.2 | 235 | 225.9 | 64.8 | 295 | 283.6 | 81.3 |
| 56 | 53.8 | 15.4 | 116 | 111.5 | 32.0 | 176 | 169.2 | 48.5 | 236 | 226.9 | 65.1 | 296 | 284.5 | 81.6 |
| 57 | 54.8 | 15.7 | 117 | 112.5 | 32.2 | 177 | 170.1 | 48.8 | 237 | 227.8 | 65.3 | 297 | 285.5 | 81.9 |
| 58 | 55.8 | 16.0 | 118 | 113.4 | 32.5 | 178 | 171.1 | 49.1 | 238 | 228.8 | 65.6 | 298 | 286.5 | 82.1 |
| 59 | 56.7 | 16.3 | 119 | 114.4 | 32.8 | 179 | 172.1 | 49.3 | 239 | 229.7 | 65.9 | 299 | 287.4 | 82.4 |
| 60 | 57.7 | 16.5 | 120 | 115.4 | 33.1 | 180 | 173.0 | 49.6 | 240 | 230.7 | 66.2 | 300 | 288.4 | 82.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 74 Degrees.

## Difference of Latitude and Departure for 17 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.3 | 61 | 58.3 | 17.8 | 121 | 115.7 | 35.4 | 181 | 173.1 | 52.9 | 241 | 230.5 | 70.5 | | | |
| 2 | 01.9 | 00.6 | 62 | 59.3 | 18.1 | 122 | 116.7 | 35.7 | 182 | 174.0 | 53.2 | 242 | 231.4 | 70.8 | | | |
| 3 | 02.9 | 00.9 | 63 | 60.2 | 18.4 | 123 | 117.6 | 36.0 | 183 | 175.0 | 53.5 | 243 | 232.4 | 71.0 | | | |
| 4 | 03.8 | 01.2 | 64 | 61.2 | 18.7 | 124 | 118.6 | 36.3 | 184 | 176.0 | 53.8 | 244 | 233.3 | 71.3 | | | |
| 5 | 04.8 | 01.5 | 65 | 62.2 | 19.0 | 125 | 119.5 | 36.5 | 185 | 176.9 | 54.1 | 245 | 234.3 | 71.6 | | | |
| 6 | 05.7 | 01.8 | 66 | 63.1 | 19.3 | 126 | 120.5 | 36.8 | 186 | 177.9 | 54.4 | 246 | 235.3 | 71.9 | | | |
| 7 | 06.7 | 02.0 | 67 | 64.1 | 19.6 | 127 | 121.5 | 37.1 | 187 | 178.8 | 54.7 | 247 | 236.2 | 72.2 | | | |
| 8 | 07.7 | 02.3 | 68 | 65.0 | 19.9 | 128 | 122.4 | 37.4 | 188 | 179.8 | 55.0 | 248 | 237.2 | 72.5 | | | |
| 9 | 08.6 | 02.6 | 69 | 66.0 | 20.2 | 129 | 123.4 | 37.7 | 189 | 180.7 | 55.3 | 249 | 238.1 | 72.8 | | | |
| 10 | 09.6 | 02.9 | 70 | 66.9 | 20.5 | 130 | 124.3 | 38.0 | 190 | 181.7 | 55.6 | 250 | 239.1 | 73.1 | | | |
| 11 | 10.5 | 03.2 | 71 | 67.9 | 20.8 | 131 | 125.3 | 38.3 | 191 | 182.7 | 55.8 | 251 | 240.0 | 73.4 | | | |
| 12 | 11.5 | 03.5 | 72 | 68.9 | 21.1 | 132 | 126.2 | 38.6 | 192 | 183.6 | 56.1 | 252 | 241.0 | 73.7 | | | |
| 13 | 12.4 | 03.8 | 73 | 69.8 | 21.3 | 133 | 127.2 | 38.9 | 193 | 184.6 | 56.4 | 253 | 241.9 | 74.0 | | | |
| 14 | 13.4 | 04.1 | 74 | 70.8 | 21.6 | 134 | 128.1 | 39.2 | 194 | 185.5 | 56.7 | 254 | 242.9 | 74.3 | | | |
| 15 | 14.3 | 04.4 | 75 | 71.7 | 21.9 | 135 | 129.1 | 39.5 | 195 | 186.5 | 57.0 | 255 | 243.9 | 74.6 | | | |
| 16 | 15.3 | 04.7 | 76 | 72.7 | 22.2 | 136 | 130.1 | 39.8 | 196 | 187.4 | 57.3 | 256 | 244.8 | 74.8 | | | |
| 17 | 16.3 | 05.0 | 77 | 73.6 | 22.5 | 137 | 131.0 | 40.1 | 197 | 188.4 | 57.6 | 257 | 245.8 | 75.1 | | | |
| 18 | 17.2 | 05.3 | 78 | 74.6 | 22.8 | 138 | 132.0 | 40.3 | 198 | 189.3 | 57.9 | 258 | 246.7 | 75.4 | | | |
| 19 | 18.2 | 05.6 | 79 | 75.5 | 23.1 | 139 | 132.9 | 40.6 | 199 | 190.3 | 58.2 | 259 | 247.7 | 75.7 | | | |
| 20 | 19.1 | 05.8 | 80 | 76.5 | 23.3 | 140 | 133.9 | 40.9 | 200 | 191.3 | 58.5 | 260 | 248.6 | 76.0 | | | |
| 21 | 20.1 | 06.1 | 81 | 77.5 | 23.7 | 141 | 134.8 | 41.2 | 201 | 192.2 | 58.8 | 261 | 249.6 | 76.3 | | | |
| 22 | 21.0 | 06.4 | 82 | 78.4 | 24.0 | 142 | 135.8 | 41.5 | 202 | 193.2 | 59.1 | 262 | 250.6 | 76.6 | | | |
| 23 | 22.0 | 06.7 | 83 | 79.4 | 24.3 | 143 | 136.8 | 41.8 | 203 | 194.1 | 59.4 | 263 | 251.5 | 76.9 | | | |
| 24 | 23.0 | 07.0 | 84 | 80.3 | 24.6 | 144 | 137.7 | 42.1 | 204 | 195.1 | 59.6 | 264 | 252.5 | 77.2 | | | |
| 25 | 23.9 | 07.3 | 85 | 81.3 | 24.9 | 145 | 138.7 | 42.4 | 205 | 196.0 | 59.9 | 265 | 253.4 | 77.5 | | | |
| 26 | 24.9 | 07.6 | 86 | 82.2 | 25.1 | 146 | 139.6 | 42.7 | 206 | 197.0 | 60.2 | 266 | 254.4 | 77.8 | | | |
| 27 | 25.8 | 07.9 | 87 | 83.2 | 25.4 | 147 | 140.6 | 43.0 | 207 | 198.0 | 60.5 | 267 | 255.3 | 78.1 | | | |
| 28 | 26.8 | 08.2 | 88 | 84.2 | 25.7 | 148 | 141.5 | 43.3 | 208 | 198.9 | 60.8 | 268 | 256.3 | 78.4 | | | |
| 29 | 27.7 | 08.5 | 89 | 85.1 | 26.0 | 149 | 142.5 | 43.6 | 209 | 199.9 | 61.1 | 269 | 257.2 | 78.6 | | | |
| 30 | 28.7 | 08.8 | 90 | 86.1 | 26.3 | 150 | 143.4 | 43.9 | 210 | 200.8 | 61.4 | 270 | 258.2 | 78.9 | | | |
| 31 | 29.6 | 09.1 | 91 | 87.0 | 26.6 | 151 | 144.4 | 44.1 | 211 | 201.8 | 61.7 | 271 | 259.2 | 79.2 | | | |
| 32 | 30.6 | 09.4 | 92 | 88.0 | 26.9 | 152 | 145.4 | 44.4 | 212 | 202.7 | 62.0 | 272 | 260.1 | 79.5 | | | |
| 33 | 31.6 | 09.6 | 93 | 88.9 | 27.2 | 153 | 146.3 | 44.7 | 213 | 203.7 | 62.3 | 273 | 261.1 | 79.8 | | | |
| 34 | 32.5 | 09.9 | 94 | 89.9 | 27.5 | 154 | 147.3 | 45.0 | 214 | 204.6 | 62.6 | 274 | 262.0 | 80.1 | | | |
| 35 | 33.5 | 10.2 | 95 | 90.8 | 27.8 | 155 | 148.2 | 45.3 | 215 | 205.6 | 62.9 | 275 | 263.0 | 80.4 | | | |
| 36 | 34.4 | 10.5 | 96 | 91.8 | 28.1 | 156 | 149.2 | 45.6 | 216 | 206.6 | 63.2 | 276 | 263.9 | 80.7 | | | |
| 37 | 35.4 | 10.8 | 97 | 92.8 | 28.4 | 157 | 150.1 | 45.9 | 217 | 207.5 | 63.4 | 277 | 264.9 | 81.0 | | | |
| 38 | 36.3 | 11.1 | 98 | 93.7 | 28.7 | 158 | 151.1 | 46.2 | 218 | 208.5 | 63.7 | 278 | 265.9 | 81.3 | | | |
| 39 | 37.3 | 11.4 | 99 | 94.7 | 28.9 | 159 | 152.1 | 46.5 | 219 | 209.4 | 64.0 | 279 | 266.8 | 81.6 | | | |
| 40 | 38.3 | 11.7 | 100 | 95.6 | 29.2 | 160 | 153.0 | 46.8 | 220 | 210.4 | 64.3 | 280 | 267.8 | 81.9 | | | |
| 41 | 39.2 | 12.0 | 101 | 96.6 | 29.5 | 161 | 154.0 | 47.1 | 221 | 211.3 | 64.6 | 281 | 268.7 | 82.2 | | | |
| 42 | 40.2 | 12.3 | 102 | 97.5 | 29.8 | 162 | 154.9 | 47.4 | 222 | 212.3 | 64.9 | 282 | 269.7 | 82.4 | | | |
| 43 | 41.1 | 12.6 | 103 | 98.5 | 30.1 | 163 | 155.9 | 47.7 | 223 | 213.3 | 65.2 | 283 | 270.6 | 82.7 | | | |
| 44 | 42.1 | 12.9 | 104 | 99.5 | 30.4 | 164 | 156.8 | 47.9 | 224 | 214.2 | 65.5 | 284 | 271.6 | 83.0 | | | |
| 45 | 43.0 | 13.2 | 105 | 100.4 | 30.7 | 165 | 157.8 | 48.2 | 225 | 215.2 | 65.8 | 285 | 272.5 | 83.3 | | | |
| 46 | 44.0 | 13.4 | 106 | 101.4 | 31.0 | 166 | 158.7 | 48.5 | 226 | 216.1 | 66.1 | 286 | 273.5 | 83.6 | | | |
| 47 | 44.9 | 13.7 | 107 | 102.3 | 31.3 | 167 | 159.7 | 48.8 | 227 | 217.1 | 66.4 | 287 | 274.5 | 83.9 | | | |
| 48 | 45.9 | 14.0 | 108 | 103.3 | 31.6 | 168 | 160.7 | 49.1 | 228 | 218.0 | 66.7 | 288 | 275.4 | 84.2 | | | |
| 49 | 46.9 | 14.3 | 109 | 104.2 | 31.9 | 169 | 161.6 | 49.4 | 229 | 219.0 | 67.0 | 289 | 276.4 | 84.5 | | | |
| 50 | 47.8 | 14.6 | 110 | 105.2 | 32.2 | 170 | 162.6 | 49.7 | 230 | 220.0 | 67.2 | 290 | 277.3 | 84.8 | | | |
| 51 | 48.8 | 14.9 | 111 | 106.1 | 32.5 | 171 | 163.5 | 50.0 | 231 | 220.9 | 67.5 | 291 | 278.3 | 85.1 | | | |
| 52 | 49.7 | 15.2 | 112 | 107.1 | 32.7 | 172 | 164.5 | 50.3 | 232 | 221.9 | 67.8 | 292 | 279.2 | 85.4 | | | |
| 53 | 50.7 | 15.5 | 113 | 108.1 | 33.0 | 173 | 165.4 | 50.6 | 233 | 222.8 | 68.1 | 293 | 280.2 | 85.7 | | | |
| 54 | 51.6 | 15.8 | 114 | 109.0 | 33.3 | 174 | 166.4 | 50.9 | 234 | 223.8 | 68.4 | 294 | 281.2 | 86.0 | | | |
| 55 | 52.6 | 16.1 | 115 | 110.0 | 33.6 | 175 | 167.4 | 51.2 | 235 | 224.7 | 68.7 | 295 | 282.1 | 86.2 | | | |
| 56 | 53.6 | 16.4 | 116 | 110.9 | 33.9 | 176 | 168.3 | 51.5 | 236 | 225.7 | 69.0 | 296 | 283.1 | 86.5 | | | |
| 57 | 54.5 | 16.7 | 117 | 111.9 | 34.2 | 177 | 169.3 | 51.7 | 237 | 226.6 | 69.3 | 297 | 284.0 | 86.8 | | | |
| 58 | 55.5 | 17.0 | 118 | 112.8 | 34.5 | 178 | 170.2 | 52.0 | 238 | 227.6 | 69.6 | 298 | 285.0 | 87.1 | | | |
| 59 | 56.4 | 17.2 | 119 | 113.8 | 34.8 | 179 | 171.2 | 52.3 | 239 | 228.6 | 69.9 | 299 | 285.9 | 87.4 | | | |
| 60 | 57.4 | 17.5 | 120 | 114.8 | 35.1 | 180 | 172.1 | 52.6 | 240 | 229.5 | 70.2 | 300 | 286.9 | 87.7 | | | |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 18 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01.0 | 00.3 | 61 | 58.0 | 18.9 | 121 | 115.1 | 37.4 | 181 | 172.1 | 55.9 | 241 | 229.2 | 74.5 |
| 2 | 01.9 | 00.6 | 62 | 59.0 | 19.2 | 122 | 116.0 | 37.7 | 182 | 173.1 | 56.2 | 242 | 230.2 | 74.8 |
| 3 | 02.9 | 00.9 | 63 | 59.9 | 19.5 | 123 | 117.0 | 38.0 | 183 | 174.0 | 56.6 | 243 | 231.1 | 75.1 |
| 4 | 03.8 | 01.2 | 64 | 60.9 | 19.8 | 124 | 117.9 | 38.3 | 184 | 175.0 | 56.9 | 244 | 232.1 | 75.4 |
| 5 | 04.8 | 01.5 | 65 | 61.8 | 20.1 | 125 | 118.9 | 38.6 | 185 | 175.9 | 57.2 | 245 | 233.0 | 75.7 |
| 6 | 05.7 | 01.9 | 66 | 62.8 | 20.4 | 126 | 119.8 | 38.9 | 186 | 176.9 | 57.5 | 246 | 234.0 | 76.0 |
| 7 | 06.7 | 02.2 | 67 | 63.7 | 20.7 | 127 | 120.8 | 39.2 | 187 | 177.8 | 57.8 | 247 | 234.9 | 76.3 |
| 8 | 07.6 | 02.5 | 68 | 64.7 | 21.0 | 128 | 121.7 | 39.6 | 188 | 178.8 | 58.1 | 248 | 235.9 | 76.6 |
| 9 | 08.6 | 02.8 | 69 | 65.6 | 21.3 | 129 | 122.7 | 39.9 | 189 | 179.7 | 58.4 | 249 | 236.8 | 76.9 |
| 10 | 09.5 | 03.1 | 70 | 66.6 | 21.6 | 130 | 123.6 | 40.2 | 190 | 180.7 | 58.7 | 250 | 237.8 | 77.3 |
| 11 | 10.5 | 03.4 | 71 | 67.5 | 21.9 | 131 | 124.6 | 40.5 | 191 | 181.7 | 59.0 | 251 | 238.7 | 77.6 |
| 12 | 11.4 | 03.7 | 72 | 68.5 | 22.2 | 132 | 125.5 | 40.8 | 192 | 182.6 | 59.3 | 252 | 239.7 | 77.9 |
| 13 | 12.4 | 04.0 | 73 | 69.4 | 22.6 | 133 | 126.5 | 41.1 | 193 | 183.6 | 59.6 | 253 | 240.6 | 78.2 |
| 14 | 13.3 | 04.3 | 74 | 70.4 | 22.9 | 134 | 127.4 | 41.4 | 194 | 184.5 | 59.9 | 254 | 241.6 | 78.5 |
| 15 | 14.3 | 04·6 | 75 | 71.3 | 23.2 | 135 | 128.4 | 41.7 | 195 | 185.5 | 60.3 | 255 | 242.5 | 78.8 |
| 16 | 15.2 | 04.9 | 76 | 72.3 | 23.5 | 136 | 129.3 | 42.0 | 196 | 186.4 | 60.6 | 256 | 243.5 | 79.1 |
| 17 | 16.2 | 05.3 | 77 | 73.2 | 23.8 | 137 | 130.3 | 42.3 | 197 | 187.4 | 60.9 | 257 | 244.4 | 79.4 |
| 18 | 17.1 | 05.6 | 78 | 74.2 | 24.1 | 138 | 131.2 | 42.6 | 198 | 188.3 | 61.2 | 258 | 245.4 | 79.7 |
| 19 | 18.1 | 05.9 | 79 | 75.1 | 24.4 | 139 | 132.2 | 43.0 | 199 | 189.3 | 61.5 | 259 | 246.3 | 80.0 |
| 20 | 19.0 | 06.2 | 80 | 76.1 | 24.7 | 140 | 133.1 | 43.3 | 200 | 190.2 | 61.8 | 260 | 247.3 | 80.3 |
| 21 | 20.0 | 06.5 | 81 | 77.0 | 25.0 | 141 | 134.1 | 43.6 | 201 | 191.2 | 62.1 | 261 | 248.2 | 80.7 |
| 22 | 20.9 | 06.8 | 82 | 78.0 | 25.3 | 142 | 135.1 | 43.9 | 202 | 192.1 | 62.4 | 262 | 249.2 | 81.0 |
| 23 | 21.9 | 07.1 | 83 | 78.9 | 25.6 | 143 | 136.0 | 44.2 | 203 | 193.1 | 62.7 | 263 | 250.1 | 81.3 |
| 24 | 22.8 | 07.4 | 84 | 79.9 | 26.0 | 144 | 137.0 | 44.5 | 204 | 194.0 | 63.0 | 264 | 251.1 | 81.6 |
| 25 | 23.8 | 07 7 | 85 | 80.8 | 26.3 | 145 | 137.9 | 44.8 | 205 | 195.0 | 63.3 | 265 | 252.0 | 81.9 |
| 26 | 24.7 | 08.0 | 86 | 81.8 | 26.6 | 146 | 138.9 | 45.1 | 206 | 195.9 | 63.7 | 266 | 253.0 | 82.2 |
| 27 | 25.7 | 08.3 | 87 | 82.7 | 26.9 | 147 | 139.8 | 45.4 | 207 | 196.9 | 64.0 | 267 | 253.9 | 82.5 |
| 28 | 26.6 | 08.7 | 88 | 83.7 | 27.2 | 148 | 140.8 | 45.7 | 208 | 197.8 | 64.3 | 268 | 254.9 | 82.8 |
| 29 | 27.6 | 09.0 | 89 | 84.6 | 27.5 | 149 | 141.7 | 46.0 | 209 | 198.8 | 64.6 | 269 | 255.8 | 83.1 |
| 30 | 28.5 | 09.3 | 90 | 85.6 | 27.8 | 150 | 142.7 | 46.4 | 210 | 199.7 | 64.9 | 270 | 256.8 | 83.4 |
| 31 | 29.5 | 09.6 | 91 | 86.5 | 28.1 | 151 | 143.6 | 46.7 | 211 | 200.7 | 65.2 | 271 | 257.7 | 83.7 |
| 32 | 30.4 | 09.9 | 92 | 87.5 | 28.4 | 152 | 144.6 | 47.0 | 212 | 201.6 | 65.5 | 272 | 258.7 | 84.1 |
| 33 | 31.4 | 10.2 | 93 | 88.4 | 28.7 | 153 | 145.5 | 47.3 | 213 | 202.6 | 65.8 | 273 | 259.6 | 84.4 |
| 34 | 32.3 | 10.5 | 94 | 89.4 | 29.0 | 154 | 146.5 | 47.6 | 214 | 203.5 | 66.1 | 274 | 260.6 | 84.7 |
| 35 | 33.3 | 10.8 | 95 | 90.4 | 29.4 | 155 | 147.4 | 47.9 | 215 | 204.5 | 66.4 | 275 | 261.5 | 85.0 |
| 36 | 34.2 | 11.1 | 96 | 91.3 | 29.7 | 156 | 148.4 | 48.2 | 216 | 205.4 | 66.7 | 276 | 262.5 | 85.3 |
| 37 | 35.2 | 11.4 | 97 | 92.3 | 30.0 | 157 | 149.3 | 48.5 | 217 | 206.4 | 67.1 | 277 | 263.4 | 85.6 |
| 38 | 36.1 | 11.7 | 98 | 93.2 | 30.3 | 158 | 150.3 | 48.8 | 218 | 207.3 | 67.4 | 278 | 264.4 | 85.9 |
| 39 | 37.1 | 12.1 | 99 | 94.2 | 30.6 | 159 | 151.2 | 49.1 | 219 | 208.3 | 67.7 | 279 | 265.3 | 86.2 |
| 40 | 38.0 | 12.4 | 100 | 95.1 | 30.9 | 160 | 152.2 | 49.4 | 220 | 209.2 | 68.0 | 280 | 266.3 | 86.5 |
| 41 | 39.0 | 12.7 | 101 | 96.1 | 31.2 | 161 | 153.1 | 49.8 | 221 | 210.2 | 68.3 | 281 | 267.2 | 86.8 |
| 42 | 39.9 | 13.0 | 102 | 97.0 | 31.5 | 162 | 154.1 | 50.1 | 222 | 211.1 | 68.6 | 282 | 268.2 | 87.1 |
| 43 | 40.9 | 13.3 | 103 | 98.0 | 31.8 | 163 | 155.0 | 50.4 | 223 | 212.1 | 68.9 | 283 | 269.1 | 87.5 |
| 44 | 41.8 | 13.6 | 104 | 98.9 | 32.1 | 164 | 156.0 | 50.7 | 224 | 213.0 | 69.2 | 284 | 270.1 | 87.8 |
| 45 | 42.8 | 13.9 | 105 | 99.9 | 32.4 | 165 | 156.9 | 51.0 | 225 | 214.0 | 69.5 | 285 | 271.1 | 88.1 |
| 46 | 43.7 | 14.2 | 106 | 100.8 | 32.8 | 166 | 157.9 | 51.3 | 226 | 214.9 | 69.8 | 286 | 272.0 | 88.4 |
| 47 | 44.7 | 14.5 | 107 | 101.8 | 33.1 | 167 | 158.8 | 51.6 | 227 | 215.9 | 70.1 | 287 | 273.0 | 88.7 |
| 48 | 45.7 | 14.8 | 108 | 102.7 | 33.4 | 168 | 159.8 | 51.9 | 228 | 216.8 | 70.5 | 288 | 273.9 | 89.0 |
| 49 | 46.6 | 15.1 | 109 | 103.7 | 33.7 | 169 | 160.7 | 52.2 | 229 | 217.8 | 70.8 | 289 | 274.9 | 89.3 |
| 50 | 47.6 | 15.5 | 110 | 104.6 | 34.0 | 170 | 161.7 | 52.5 | 230 | 218.7 | 71.1 | 290 | 275.8 | 89.6 |
| 51 | 48.5 | 15.8 | 111 | 105.6 | 34.3 | 171 | 162.6 | 52.8 | 231 | 219.7 | 71.4 | 291 | 276.8 | 89.9 |
| 52 | 49.5 | 16.1 | 112 | 106.5 | 34.6 | 172 | 163.6 | 53.2 | 232 | 220.6 | 71.7 | 292 | 277.7 | 90.2 |
| 53 | 50.4 | 16.4 | 113 | 107.5 | 34.9 | 173 | 164.5 | 53.5 | 233 | 221.6 | 72.0 | 293 | 278.7 | 90.5 |
| 54 | 51.4 | 16.7 | 114 | 108.4 | 35.2 | 174 | 165.5 | 53.8 | 234 | 222.5 | 72.3 | 294 | 279.6 | 90.9 |
| 55 | 52.3 | 17.0 | 115 | 109.4 | 35.5 | 175 | 166.4 | 54.1 | 235 | 223.5 | 72.6 | 295 | 280.6 | 91.2 |
| 56 | 53.3 | 17.3 | 116 | 110.3 | 35.8 | 176 | 167.4 | 54.4 | 236 | 224.4 | 72.9 | 296 | 281.5 | 91.5 |
| 57 | 54.2 | 17.6 | 117 | 111.3 | 36.2 | 177 | 168.3 | 54.7 | 237 | 225.4 | 73.2 | 297 | 282.5 | 91.8 |
| 58 | 55.2 | 17.9 | 118 | 112.2 | 36.5 | 178 | 169.3 | 55.0 | 238 | 226.4 | 73.5 | 298 | 283.4 | 92.1 |
| 59 | 56.1 | 18.2 | 119 | 113.2 | 36.8 | 179 | 170.2 | 55.3 | 239 | 227.3 | 73.9 | 299 | 284.4 | 92.4 |
| 60 | 57.1 | 18.5 | 120 | 114.1 | 37.1 | 180 | 171.2 | 55.6 | 240 | 228.3 | 74.2 | 300 | 285.3 | 92.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 72 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 19 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.3 | 61 | 57.7 | 19.9 | 121 | 114.4 | 39.4 | 181 | 171.1 | 58.9 | 241 | 227.9 | 78.5 |
| 2 | 01.9 | 00.7 | 62 | 58.6 | 20.2 | 122 | 115.4 | 39.7 | 182 | 172.1 | 59.3 | 242 | 228.8 | 78.8 |
| 3 | 02.8 | 01.0 | 63 | 59.6 | 20.5 | 123 | 116.3 | 40.0 | 183 | 173.0 | 59.6 | 243 | 229.8 | 79.1 |
| 4 | 03.8 | 01.3 | 64 | 60.5 | 20.8 | 124 | 117.2 | 40.4 | 184 | 174.0 | 59.9 | 244 | 230.7 | 79.4 |
| 5 | 04.7 | 01.6 | 65 | 61.5 | 21.2 | 125 | 118.2 | 40.7 | 185 | 174.9 | 60.2 | 245 | 231.7 | 79.8 |
| 6 | 05.7 | 02.0 | 66 | 62.4 | 21.5 | 126 | 119.1 | 41.0 | 186 | 175.9 | 60.6 | 246 | 232.6 | 80.1 |
| 7 | 06.6 | 02.3 | 67 | 63.3 | 21 8 | 127 | 120.1 | 41.3 | 187 | 176.8 | 60.9 | 247 | 233.5 | 80.4 |
| 8 | 07.6 | 02.6 | 68 | 64.3 | 22.1 | 128 | 121.0 | 41.7 | 188 | 177.8 | 61.2 | 248 | 234.5 | 80.7 |
| 9 | 08.5 | 02.9 | 69 | 65.2 | 22.5 | 129 | 122.0 | 42.0 | 189 | 178.7 | 61.5 | 249 | 235.4 | 81.1 |
| 10 | 09.5 | 03.3 | 70 | 66.2 | 22.8 | 130 | 122.9 | 42.3 | 190 | 179.6 | 61.9 | 250 | 236.4 | 81.4 |
| 11 | 10.4 | 03.6 | 71 | 67.1 | 23.1 | 131 | 123.9 | 42.6 | 191 | 180.6 | 62.2 | 251 | 237.3 | 81.7 |
| 12 | 11.3 | 03.9 | 72 | 68.1 | 23.4 | 132 | 124.8 | 43.0 | 192 | 181.5 | 62.5 | 252 | 238.3 | 82.0 |
| 13 | 12.3 | 04.2 | 73 | 69.0 | 23.8 | 133 | 125.8 | 43.3 | 193 | 182.5 | 62.8 | 253 | 239.2 | 82.4 |
| 14 | 13.2 | 04.6 | 74 | 70.0 | 24.1 | 134 | 126.7 | 43.6 | 194 | 183.4 | 63.2 | 254 | 240.2 | 82.7 |
| 15 | 14.2 | 04.9 | 75 | 70.9 | 24.4 | 135 | 127.6 | 44.0 | 195 | 184.4 | 63.5 | 255 | 241.1 | 83.0 |
| 16 | 15.1 | 05.2 | 76 | 71.9 | 24.7 | 136 | 128.6 | 44.3 | 196 | 185.3 | 63.8 | 256 | 242.1 | 83.3 |
| 17 | 16.1 | 05.5 | 77 | 72.8 | 25.1 | 137 | 129.5 | 44.6 | 197 | 186.3 | 64.1 | 257 | 243.0 | 83.7 |
| 18 | 17.0 | 05.9 | 78 | 73.8 | 25.4 | 138 | 130.5 | 44.9 | 198 | 187.2 | 64.5 | 258 | 243.9 | 84.0 |
| 19 | 18.0 | 06.2 | 79 | 74.7 | 25.7 | 139 | 131.4 | 45.3 | 199 | 188.2 | 64.8 | 259 | 244.9 | 84.3 |
| 20 | 18.9 | 06.5 | 80 | 75.6 | 26.0 | 140 | 132.4 | 45.6 | 200 | 189.1 | 65.1 | 260 | 245.8 | 84.6 |
| 21 | 19.9 | 06.8 | 81 | 76.6 | 26.4 | 141 | 133.3 | 45.9 | 201 | 190.0 | 65.4 | 261 | 246.8 | 85.0 |
| 22 | 20.8 | 07.2 | 82 | 77.5 | 26.7 | 142 | 134.3 | 46.2 | 202 | 191.0 | 65.8 | 262 | 247.7 | 85.3 |
| 23 | 21.7 | 07.5 | 83 | 78.5 | 27.0 | 143 | 135.2 | 46.6 | 203 | 191.9 | 66.1 | 263 | 248.7 | 85.6 |
| 24 | 22.7 | 07.8 | 84 | 79.4 | 27.3 | 144 | 136.2 | 46.9 | 204 | 192.9 | 66.4 | 264 | 249.6 | 86.0 |
| 25 | 23.6 | 08.1 | 85 | 80.4 | 27.7 | 145 | 137.1 | 47.2 | 205 | 193.8 | 66.7 | 265 | 250.6 | 86.3 |
| 26 | 24.6 | 08.5 | 86 | 81.3 | 28.0 | 146 | 138·0 | 47.5 | 206 | 194.8 | 67.1 | 266 | 251.5 | 86.6 |
| 27 | 25.5 | 08.8 | 87 | 82.3 | 28.3 | 147 | 139.0 | 47.9 | 207 | 195.7 | 67.4 | 267 | 252.5 | 86.9 |
| 28 | 26.5 | 09.1 | 88 | 83.2 | 28.7 | 148 | 139.9 | 48.2 | 208 | 196.7 | 67.7 | 268 | 253.4 | 87.3 |
| 29 | 27.4 | 09.4 | 89 | 84.2 | 29.0 | 149 | 140.9 | 48.5 | 209 | 197.6 | 68.0 | 269 | 254.3 | 87.6 |
| 30 | 28.4 | 09.8 | 90 | 85.1 | 29.3 | 150 | 141.8 | 48.8 | 210 | 198.6 | 68.4 | 270 | 255.3 | 87.9 |
| 31 | 29.3 | 10.1 | 91 | 86.0 | 29.6 | 151 | 142.8 | 49.2 | 211 | 199.5 | 68.7 | 271 | 256.2 | 88.2 |
| 32 | 30.3 | 10.4 | 92 | 87.0 | 30.0 | 152 | 143.7 | 49.5 | 212 | 200.4 | 69.0 | 272 | 257.2 | 88.6 |
| 33 | 31.2 | 10.7 | 93 | 87.9 | 30.3 | 153 | 144.7 | 49.8 | 213 | 201.4 | 69.3 | 273 | 258.1 | 88.9 |
| 34 | 32.1 | 11.1 | 94 | 88.9 | 30.6 | 154 | 145.6 | 50.1 | 214 | 202.3 | 69.7 | 274 | 259.1 | 89.2 |
| 35 | 33.1 | 11.4 | 95 | 89.8 | 30.9 | 155 | 146.6 | 50.5 | 215 | 203.3 | 70.0 | 275 | 260.0 | 89.5 |
| 36 | 34.0 | 11.7 | 96 | 90.8 | 31.3 | 156 | 147.5 | 50.8 | 216 | 204.2 | 70.3 | 276 | 261.0 | 89.9 |
| 37 | 35.0 | 12.0 | 97 | 91.7 | 31.6 | 157 | 148.4 | 51.1 | 217 | 205.2 | 70.6 | 277 | 261.9 | 90.2 |
| 38 | 35.9 | 12.4 | 98 | 92.7 | 31.9 | 158 | 149.4 | 51.4 | 218 | 206.1 | 71.0 | 278 | 262.9 | 90.5 |
| 39 | 36.9 | 12.7 | 99 | 93.6 | 32.2 | 159 | 150.3 | 51.8 | 219 | 207.1 | 71.3 | 279 | 263.8 | 90.8 |
| 40 | 37.8 | 13.0 | 100 | 94.6 | 32.6 | 160 | 151.3 | 52.1 | 220 | 208.0 | 71.6 | 280 | 264.7 | 91.2 |
| 41 | 38.8 | 13.3 | 101 | 95.5 | 32.9 | 161 | 152.2 | 52.4 | 221 | 209.0 | 72.0 | 281 | 265.7 | 91.5 |
| 42 | 39.7 | 13.7 | 102 | 96.4 | 33.2 | 162 | 153.2 | 52.7 | 222 | 209.9 | 72.3 | 282 | 266.6 | 91.8 |
| 43 | 40.7 | 14.0 | 103 | 97.4 | 33.5 | 163 | 154.1 | 53.1 | 223 | 210.9 | 72.6 | 283 | 267.6 | 92.1 |
| 44 | 41.6 | 14.3 | 104 | 98.3 | 33.9 | 164 | 155.1 | 53.4 | 224 | 211.8 | 72.9 | 284 | 268.5 | 92.5 |
| 45 | 42.5 | 14.7 | 105 | 99.3 | 34.2 | 165 | 156.0 | 53.7 | 225 | 212.7 | 73.3 | 285 | 269.5 | 92.8 |
| 46 | 43.5 | 15.0 | 106 | 100.2 | 34.5 | 166 | 157.0 | 54.0 | 226 | 213.7 | 73.6 | 286 | 270.4 | 93.1 |
| 47 | 44.4 | 15.3 | 107 | 101.2 | 34.8 | 167 | 157.9 | 54.4 | 227 | 214.6 | 73.9 | 287 | 271.4 | 93.4 |
| 48 | 45.4 | 15.6 | 108 | 102.1 | 35.2 | 168 | 158.8 | 54.7 | 228 | 215.6 | 74.2 | 288 | 272.3 | 93.8 |
| 49 | 46.3 | 16.0 | 109 | 103.1 | 35.5 | 169 | 159.8 | 55.0 | 229 | 216.5 | 74.6 | 289 | 273.3 | 94.1 |
| 50 | 47.3 | 16.3 | 110 | 104.0 | 35.8 | 170 | 160.7 | 55.3 | 230 | 217.5 | 74.9 | 290 | 274.2 | 94.4 |
| 51 | 48.2 | 16.6 | 111 | 105.0 | 36.1 | 171 | 161.7 | 55.7 | 231 | 218.4 | 75.2 | 291 | 275.1 | 94.7 |
| 52 | 49.2 | 16.9 | 112 | 105.9 | 36.5 | 172 | 162.6 | 56.0 | 232 | 219.4 | 75.5 | 292 | 276.1 | 95.1 |
| 53 | 50.1 | 17.3 | 113 | 106.8 | 36.8 | 173 | 163.6 | 56.3 | 233 | 220.3 | 75.9 | 293 | 277.0 | 95.4 |
| 54 | 51.1 | 17.6 | 114 | 107.8 | 37.1 | 174 | 164.5 | 56.6 | 234 | 221.3 | 76.2 | 294 | 278.0 | 95.7 |
| 55 | 52.0 | 17.9 | 115 | 108.7 | 37.4 | 175 | 165.5 | 57.0 | 235 | 222.2 | 76.5 | 295 | 278.9 | 96.0 |
| 56 | 52.9 | 18.2 | 116 | 109.7 | 37.8 | 176 | 166.4 | 57.3 | 236 | 223.1 | 76.8 | 296 | 279.9 | 96.4 |
| 57 | 53.9 | 18.6 | 117 | 110.6 | 38.1 | 177 | 167.4 | 57.6 | 237 | 224.1 | 77.2 | 297 | 280.8 | 96.7 |
| 58 | 54.8 | 18.9 | 118 | 111.6 | 38.4 | 178 | 168.3 | 58.0 | 238 | 225.0 | 77.5 | 298 | 281.8 | 97.0 |
| 59 | 55.8 | 19.2 | 119 | 112.5 | 38.7 | 179 | 169.2 | 58.3 | 239 | 226.0 | 77.8 | 299 | 282.7 | 97.3 |
| 60 | 56.7 | 19.5 | 120 | 113.5 | 39.1 | 180 | 170.2 | 58.6 | 240 | 226.9 | 78.1 | 300 | 283.7 | 97.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 71 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 20 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.3 | 61 | 57.3 | 20.9 | 121 | 113.7 | 41.4 | 181 | 170.1 | 61.9 | 241 | 226.5 | 82.4 |
| 2 | 01.9 | 00.7 | 62 | 58.3 | 21.2 | 122 | 114.6 | 41.7 | 182 | 171.0 | 62.2 | 242 | 227.4 | 82.8 |
| 3 | 02.8 | 01.0 | 63 | 59.2 | 21.5 | 123 | 115.6 | 42.1 | 183 | 172.0 | 62.6 | 243 | 228.3 | 83.1 |
| 4 | 03.8 | 01.4 | 64 | 60.1 | 21.9 | 124 | 116.5 | 42.4 | 184 | 172.9 | 62.9 | 244 | 229.3 | 83.5 |
| 5 | 04.7 | 01.7 | 65 | 61.1 | 22.2 | 125 | 117.5 | 42.8 | 185 | 173.8 | 63.3 | 245 | 230.2 | 83.8 |
| 6 | 05.6 | 02.1 | 66 | 62.0 | 22.6 | 126 | 118.4 | 43.1 | 186 | 174.8 | 63.6 | 246 | 231.2 | 84.2 |
| 7 | 06.6 | 02.4 | 67 | 63.0 | 22.9 | 127 | 119.3 | 43.4 | 187 | 175.7 | 64.0 | 247 | 232.1 | 84.5 |
| 8 | 07.5 | 02.7 | 68 | 63.9 | 23.3 | 128 | 120.3 | 43.8 | 188 | 176.7 | 64.3 | 248 | 233.0 | 84.8 |
| 9 | 08.5 | 03.1 | 69 | 64.8 | 23.6 | 129 | 121.2 | 44.1 | 189 | 177.6 | 64.6 | 249 | 234.0 | 85.2 |
| 10 | 09.4 | 03.4 | 70 | 65.8 | 23.9 | 130 | 122.2 | 44.5 | 190 | 178.5 | 65.0 | 250 | 234.9 | 85.5 |
| 11 | 10.3 | 03.8 | 71 | 66.7 | 24.3 | 131 | 123.1 | 44.8 | 191 | 179.5 | 65.3 | 251 | 235.9 | 85.8 |
| 12 | 11.3 | 04.1 | 72 | 67.7 | 24.6 | 132 | 124.0 | 45.1 | 192 | 180.4 | 65.7 | 252 | 236.8 | 86.2 |
| 13 | 12.2 | 04.4 | 73 | 68.6 | 25.0 | 133 | 125.0 | 45.5 | 193 | 181.4 | 66.0 | 253 | 237.7 | 86.5 |
| 14 | 13.2 | 04.8 | 74 | 69.5 | 25.3 | 134 | 125.9 | 45.8 | 194 | 182.3 | 66.4 | 254 | 238.7 | 86.9 |
| 15 | 14.1 | 05.1 | 75 | 70.5 | 25.7 | 135 | 126.9 | 46.2 | 195 | 183.2 | 66.7 | 255 | 239.6 | 87.2 |
| 16 | 15.0 | 05.5 | 76 | 71.4 | 26.0 | 136 | 127.8 | 46.5 | 196 | 184.2 | 67.0 | 256 | 240.6 | 87.6 |
| 17 | 16.0 | 05.8 | 77 | 72.4 | 26.3 | 137 | 128.7 | 46.9 | 197 | 185.1 | 67.4 | 257 | 241.5 | 87.9 |
| 18 | 16.9 | 06.2 | 78 | 73.3 | 26.7 | 138 | 129.7 | 47.2 | 198 | 186.1 | 67.7 | 258 | 242.4 | 88.2 |
| 19 | 17.9 | 06.5 | 79 | 74.2 | 27.0 | 139 | 130.6 | 47.5 | 199 | 187.0 | 68.1 | 259 | 243.4 | 88.6 |
| 20 | 18.8 | 06.8 | 80 | 75.2 | 27.4 | 140 | 131.6 | 47.9 | 200 | 187.9 | 68.4 | 260 | 244.3 | 88.9 |
| 21 | 19.7 | 07.2 | 81 | 76.1 | 27.7 | 141 | 132.5 | 48.2 | 201 | 188.9 | 68.7 | 261 | 245.3 | 89.3 |
| 22 | 20.7 | 07.5 | 82 | 77.1 | 28.0 | 142 | 133.4 | 48.6 | 202 | 189.8 | 69.1 | 262 | 246.2 | 89.6 |
| 23 | 21.6 | 07.9 | 83 | 78.0 | 28.4 | 143 | 134.4 | 48.9 | 203 | 190.8 | 69.4 | 263 | 247.1 | 90.0 |
| 24 | 22.6 | 08.2 | 84 | 78.9 | 28.7 | 144 | 135.3 | 49.3 | 204 | 191.7 | 69.8 | 264 | 248.1 | 90.3 |
| 25 | 23.5 | 08.6 | 85 | 79.9 | 29.1 | 145 | 136.3 | 49.6 | 205 | 192.6 | 70.1 | 265 | 249.0 | 90.6 |
| 26 | 24.4 | 08.9 | 86 | 80.8 | 29.4 | 146 | 137.2 | 49.9 | 206 | 193.6 | 70.5 | 266 | 250.0 | 91.0 |
| 27 | 25.4 | 09.2 | 87 | 81.8 | 29.8 | 147 | 138.1 | 50.3 | 207 | 194.5 | 70.8 | 267 | 250.9 | 91.3 |
| 28 | 26.3 | 09.6 | 88 | 82.7 | 30.1 | 148 | 139.1 | 50.6 | 208 | 195.5 | 71.1 | 268 | 251.8 | 91.7 |
| 29 | 27.3 | 09.9 | 89 | 83.6 | 30.4 | 149 | 140.0 | 51.0 | 209 | 196.4 | 71.5 | 269 | 252.8 | 92.0 |
| 30 | 28.2 | 10.3 | 90 | 84.6 | 30.8 | 150 | 141.0 | 51.3 | 210 | 197.3 | 71.8 | 270 | 253.7 | 92.3 |
| 31 | 29.1 | 10.6 | 91 | 85.5 | 31.1 | 151 | 141.9 | 51.6 | 211 | 198.3 | 72.2 | 271 | 254.7 | 92.7 |
| 32 | 30.1 | 10.9 | 92 | 86.5 | 31.5 | 152 | 142.8 | 52.0 | 212 | 199.2 | 72.5 | 272 | 255.6 | 93.0 |
| 33 | 31.0 | 11.3 | 93 | 87.4 | 31.8 | 153 | 143.8 | 52.3 | 213 | 200.2 | 72.9 | 273 | 256.5 | 93.4 |
| 34 | 31.9 | 11.6 | 94 | 88.3 | 32.1 | 154 | 144.7 | 52.7 | 214 | 201.1 | 73.2 | 274 | 257.5 | 93.7 |
| 35 | 32 9 | 12.0 | 95 | 89.3 | 32.5 | 155 | 145.7 | 53.0 | 215 | 202.0 | 73.5 | 275 | 258.4 | 94.1 |
| 36 | 33.8 | 12.3 | 96 | 90.2 | 32.8 | 156 | 146.6 | 53.4 | 216 | 203.0 | 73.9 | 276 | 259.4 | 94.4 |
| 37 | 34.8 | 12.7 | 97 | 91.2 | 33.2 | 157 | 147.5 | 53.7 | 217 | 203.9 | 74.2 | 277 | 260.3 | 94.7 |
| 38 | 35.7 | 13.0 | 98 | 92.1 | 33.5 | 158 | 148.5 | 54.0 | 218 | 204.9 | 74.6 | 278 | 261.2 | 95.1 |
| 39 | 36.6 | 13.3 | 99 | 93.0 | 33.9 | 159 | 149.4 | 54.4 | 219 | 205.8 | 74.9 | 279 | 262.2 | 95.4 |
| 40 | 37.6 | 13.7 | 100 | 94.0 | 34.2 | 160 | 150.4 | 54.7 | 220 | 206.7 | 75.2 | 280 | 263.1 | 95.8 |
| 41 | 38.5 | 14.0 | 101 | 94.9 | 34.5 | 161 | 151.3 | 55.1 | 221 | 207.7 | 75.6 | 281 | 264.1 | 96.1 |
| 42 | 39.5 | 14.4 | 102 | 95.8 | 34.9 | 162 | 152.2 | 55.4 | 222 | 208.6 | 75.9 | 282 | 265.0 | 96.4 |
| 43 | 40.4 | 14.7 | 103 | 96.8 | 35.2 | 163 | 153.2 | 55.7 | 223 | 209.6 | 76.3 | 283 | 265.9 | 96.8 |
| 44 | 41.3 | 15.0 | 104 | 97.7 | 35.6 | 164 | 154.1 | 56.1 | 224 | 210.5 | 76.6 | 284 | 266.9 | 97.1 |
| 45 | 42.3 | 15.4 | 105 | 98.7 | 35.9 | 165 | 155.0 | 56.4 | 225 | 211.4 | 77.0 | 285 | 267.8 | 97.5 |
| 46 | 43.2 | 15.7 | 106 | 99.6 | 36.3 | 166 | 156.0 | 56.8 | 226 | 212.4 | 77.3 | 286 | 268.8 | 97.8 |
| 47 | 44.2 | 16.1 | 107 | 100.5 | 36.6 | 167 | 156.9 | 57.1 | 227 | 213.3 | 77.6 | 287 | 269.7 | 98.2 |
| 48 | 45.1 | 16.4 | 108 | 101.5 | 36.9 | 168 | 157.9 | 57.5 | 228 | 214.2 | 78.0 | 288 | 270.6 | 98.5 |
| 49 | 46.0 | 16.8 | 109 | 102.4 | 37.3 | 169 | 158.8 | 57.8 | 229 | 215.2 | 78.3 | 289 | 271.6 | 98.8 |
| 50 | 47.0 | 17.1 | 110 | 103.4 | 37.6 | 170 | 159.7 | 58.1 | 230 | 216.1 | 78.7 | 290 | 272.5 | 99.2 |
| 51 | 47.9 | 17.4 | 111 | 104.3 | 38.0 | 171 | 160.7 | 58.5 | 231 | 217.1 | 79.0 | 291 | 273.5 | 99.5 |
| 52 | 48.9 | 17.8 | 112 | 105.2 | 38.3 | 172 | 161.6 | 58.8 | 232 | 218.0 | 79.3 | 292 | 274.4 | 99.9 |
| 53 | 49.8 | 18.1 | 113 | 106.2 | 38.6 | 173 | 162.6 | 59.2 | 233 | 218.9 | 79.7 | 293 | 275.3 | 100.2 |
| 54 | 50.7 | 18.5 | 114 | 107.1 | 39.0 | 174 | 163.5 | 59.5 | 234 | 219.9 | 80.0 | 294 | 276.3 | 100.6 |
| 55 | 51.7 | 18.8 | 115 | 108.1 | 39.3 | 175 | 164.4 | 59.9 | 235 | 220.8 | 80.4 | 295 | 277.2 | 100.9 |
| 56 | 52.6 | 19.2 | 116 | 109.0 | 39.7 | 176 | 165.4 | 60.2 | 236 | 221.8 | 80.7 | 296 | 278.1 | 101.2 |
| 57 | 53.6 | 19.5 | 117 | 109.9 | 40.0 | 177 | 166.3 | 60.5 | 237 | 222.7 | 81.1 | 297 | 279.1 | 101.6 |
| 58 | 54.5 | 19.8 | 118 | 110.9 | 40.4 | 178 | 167.3 | 60.9 | 238 | 223.6 | 81.4 | 298 | 280.0 | 101.9 |
| 59 | 55.4 | 20.2 | 119 | 111.8 | 40.7 | 179 | 168.2 | 61.2 | 239 | 224.6 | 81.7 | 299 | 281.0 | 102.3 |
| 60 | 56.4 | 20.5 | 120 | 112.8 | 41.0 | 180 | 169.1 | 61.6 | 240 | 225.5 | 82.1 | 300 | 281.9 | 102.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 70 Degrees.

Lat. | Dist. | Dep.

## Difference of Latitude and Departure for 21 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 56.9 | 21.9 | 121 | 113.0 | 43.4 | 181 | 169.0 | 64.9 | 241 | 225.0 | 86.4 |
| 2 | 01.9 | 00.7 | 62 | 57.9 | 22.2 | 122 | 113.9 | 43.7 | 182 | 169.9 | 65.2 | 242 | 225.9 | 86.7 |
| 3 | 02.8 | 01.1 | 63 | 58.8 | 22.6 | 123 | 114.8 | 44.1 | 183 | 170.8 | 65.6 | 243 | 226.9 | 87.1 |
| 4 | 03.7 | 01.4 | 64 | 59.7 | 22.9 | 124 | 115.8 | 44.4 | 184 | 171.8 | 65.9 | 244 | 227.8 | 87.4 |
| 5 | 04.7 | 01.8 | 65 | 60.7 | 23.3 | 125 | 116.7 | 44.8 | 185 | 172.7 | 66.3 | 245 | 228.7 | 87.8 |
| 6 | 05.6 | 02.2 | 66 | 61.6 | 23.7 | 126 | 117.6 | 45.2 | 186 | 173.6 | 66.7 | 246 | 229.7 | 88.2 |
| 7 | 06.5 | 02.5 | 67 | 62.5 | 24.0 | 127 | 118.6 | 45.5 | 187 | 174.6 | 67.0 | 247 | 230.6 | 88.5 |
| 8 | 07.5 | 02.9 | 68 | 63.5 | 24.4 | 128 | 119.5 | 45.9 | 188 | 175.5 | 67.4 | 248 | 231.5 | 88.9 |
| 9 | 08.4 | 03.2 | 69 | 64.4 | 24.7 | 129 | 120.4 | 46.2 | 189 | 176.4 | 67.7 | 249 | 232.5 | 89.2 |
| 10 | 09.3 | 03.6 | 70 | 65.4 | 25.1 | 130 | 121.4 | 46.6 | 190 | 177.4 | 68.1 | 250 | 233.4 | 89.6 |
| 11 | 10.3 | 03.9 | 71 | 66.3 | 25.4 | 131 | 122.3 | 46.9 | 191 | 178.3 | 68.4 | 251 | 234.3 | 90.0 |
| 12 | 11.2 | 04.3 | 72 | 67.2 | 25.8 | 132 | 123.2 | 47.3 | 192 | 179.2 | 68.8 | 252 | 235.3 | 90.3 |
| 13 | 12.1 | 04.7 | 73 | 68.2 | 26.2 | 133 | 124.2 | 47.7 | 193 | 180.2 | 69.2 | 253 | 236.2 | 90.7 |
| 14 | 13.1 | 05.0 | 74 | 69.1 | 26.5 | 134 | 125.1 | 48.0 | 194 | 181.1 | 69.5 | 254 | 237.1 | 91.0 |
| 15 | 14.0 | 05.4 | 75 | 70.0 | 26.9 | 135 | 126.0 | 48.4 | 195 | 182.0 | 69.9 | 255 | 238.1 | 91.4 |
| 16 | 14.9 | 05.7 | 76 | 71.0 | 27.2 | 136 | 127.0 | 48.7 | 196 | 183.0 | 70.2 | 256 | 239.0 | 91.7 |
| 17 | 15.9 | 06.1 | 77 | 71.9 | 27.6 | 137 | 127.9 | 49.1 | 197 | 183.9 | 70.6 | 257 | 239.9 | 92.1 |
| 18 | 16.8 | 06.5 | 78 | 72.8 | 28.0 | 138 | 128.8 | 49.5 | 198 | 184.8 | 71.0 | 258 | 240.9 | 92.5 |
| 19 | 17.7 | 06.8 | 79 | 73.8 | 28.3 | 139 | 129.8 | 49.8 | 199 | 185.8 | 71.3 | 259 | 241.8 | 92.8 |
| 20 | 18.7 | 07.2 | 80 | 74.7 | 28.7 | 140 | 130.7 | 50.2 | 200 | 186.7 | 71.7 | 260 | 242.7 | 93.2 |
| 21 | 19.6 | 07.5 | 81 | 75.6 | 29.0 | 141 | 131.6 | 50.5 | 201 | 187.6 | 72.0 | 261 | 243.7 | 93.5 |
| 22 | 20.5 | 07.9 | 82 | 76.6 | 29.4 | 142 | 132.6 | 50.9 | 202 | 188.6 | 72.4 | 262 | 244.6 | 93.9 |
| 23 | 21.5 | 08.2 | 83 | 77.5 | 29.7 | 143 | 133.5 | 51.2 | 203 | 189.5 | 72.7 | 263 | 245.5 | 94.2 |
| 24 | 22.4 | 08.6 | 84 | 78.4 | 30.1 | 144 | 134.4 | 51.6 | 204 | 190.4 | 73.1 | 264 | 246.5 | 94.6 |
| 25 | 23.3 | 09.0 | 85 | 79.4 | 30.5 | 145 | 135.4 | 52.0 | 205 | 191.4 | 73.5 | 265 | 247.4 | 95.0 |
| 26 | 24.3 | 09.3 | 86 | 80.3 | 30.8 | 146 | 136.3 | 52.3 | 206 | 192.3 | 73.8 | 266 | 248.3 | 95.3 |
| 27 | 25.2 | 09.7 | 87 | 81.2 | 31.2 | 147 | 137.2 | 52.7 | 207 | 193.3 | 74.2 | 267 | 249.3 | 95.7 |
| 28 | 26.1 | 10.0 | 88 | 82.2 | 31.5 | 148 | 138.2 | 53.0 | 208 | 194.2 | 74.5 | 268 | 250.2 | 96.0 |
| 29 | 27.1 | 10.4 | 89 | 83.1 | 31.9 | 149 | 139.1 | 53.4 | 209 | 195.1 | 74.9 | 269 | 251.1 | 96.4 |
| 30 | 28.0 | 10.8 | 90 | 84.0 | 32.3 | 150 | 140.0 | 53.8 | 210 | 196.1 | 75.3 | 270 | 252.1 | 96.8 |
| 31 | 28.9 | 11.1 | 91 | 85.0 | 32.6 | 151 | 141.0 | 54.1 | 211 | 197.0 | 75.6 | 271 | 253.0 | 97.1 |
| 32 | 29.9 | 11.5 | 92 | 85.9 | 33.0 | 152 | 141.9 | 54.5 | 212 | 197.9 | 76.0 | 272 | 253.9 | 97.5 |
| 33 | 30.8 | 11.8 | 93 | 86.8 | 33.3 | 153 | 142.8 | 54.8 | 213 | 198.9 | 76.3 | 273 | 254.9 | 97.8 |
| 34 | 31.7 | 12.2 | 94 | 87.8 | 33.7 | 154 | 143.8 | 55.2 | 214 | 199.8 | 76.7 | 274 | 255.8 | 98.2 |
| 35 | 32.7 | 12.5 | 95 | 88.7 | 34.0 | 155 | 144.7 | 55.5 | 215 | 200.7 | 77.0 | 275 | 256.7 | 98.6 |
| 36 | 33.6 | 12.9 | 96 | 89.6 | 34.4 | 156 | 145.6 | 55.9 | 216 | 201.7 | 77.4 | 276 | 257.7 | 98.9 |
| 37 | 34.5 | 13.3 | 97 | 90.6 | 34.8 | 157 | 146.6 | 56.3 | 217 | 202.6 | 77.8 | 277 | 258.6 | 99.3 |
| 38 | 35.5 | 13.6 | 98 | 91.5 | 35.1 | 158 | 147.5 | 56.6 | 218 | 203.5 | 78.1 | 278 | 259.5 | 99.6 |
| 39 | 36.4 | 14.0 | 99 | 92.4 | 35.5 | 159 | 148.4 | 57.0 | 219 | 204.5 | 78.5 | 279 | 260.5 | 100.0 |
| 40 | 37.3 | 14.3 | 100 | 93.4 | 35.8 | 160 | 149.4 | 57.3 | 220 | 205.4 | 78.8 | 280 | 261.4 | 100.3 |
| 41 | 38.3 | 14.7 | 101 | 94.3 | 36.2 | 161 | 150.3 | 57.7 | 221 | 206.3 | 79.2 | 281 | 262.3 | 100.7 |
| 42 | 39.2 | 15.1 | 102 | 95.2 | 36.6 | 162 | 151.2 | 58.1 | 222 | 207.3 | 79.6 | 282 | 263.3 | 101.1 |
| 43 | 40.1 | 15.4 | 103 | 96.2 | 36.9 | 163 | 152.2 | 58.4 | 223 | 208.2 | 79.9 | 283 | 264.2 | 101.4 |
| 44 | 41.1 | 15.8 | 104 | 97.1 | 37.3 | 164 | 153.1 | 58.8 | 224 | 209.1 | 80.3 | 284 | 265.1 | 101.8 |
| 45 | 42.0 | 16.1 | 105 | 98.0 | 37.6 | 165 | 154.0 | 59.1 | 225 | 210.1 | 80.6 | 285 | 266.1 | 102.1 |
| 46 | 42.9 | 16.5 | 106 | 99.0 | 38.0 | 166 | 155.0 | 59.5 | 226 | 211.0 | 81.0 | 286 | 267.0 | 102.5 |
| 47 | 43.9 | 16.8 | 107 | 99.9 | 38.3 | 167 | 155.9 | 59.8 | 227 | 211.9 | 81.3 | 287 | 267.9 | 102.9 |
| 48 | 44.8 | 17.2 | 108 | 100.8 | 38.7 | 168 | 156.8 | 60.2 | 228 | 212.9 | 81.7 | 288 | 268.9 | 103.2 |
| 49 | 45.7 | 17.6 | 109 | 101.8 | 39.1 | 169 | 157.8 | 60.6 | 229 | 213.8 | 82.1 | 289 | 269.8 | 103.6 |
| 50 | 46.7 | 17.9 | 110 | 102.7 | 39.4 | 170 | 158.7 | 60.9 | 230 | 214.7 | 82.4 | 290 | 270.7 | 103.9 |
| 51 | 47.6 | 18.3 | 111 | 103.6 | 39.8 | 171 | 159.6 | 61.3 | 231 | 215.7 | 82.8 | 291 | 271.7 | 104.3 |
| 52 | 48.5 | 18.6 | 112 | 104.6 | 40.1 | 172 | 160.6 | 61.6 | 232 | 216.6 | 83.1 | 292 | 272.6 | 104.6 |
| 53 | 49.5 | 19.0 | 113 | 105.5 | 40.5 | 173 | 161.5 | 62.0 | 233 | 217.5 | 83.5 | 293 | 273.5 | 105.0 |
| 54 | 50.4 | 19.4 | 114 | 106.4 | 40.9 | 174 | 162.4 | 62.4 | 234 | 218.5 | 83.9 | 294 | 274.5 | 105.4 |
| 55 | 51.3 | 19.7 | 115 | 107.4 | 41.2 | 175 | 163.4 | 62.7 | 235 | 219.4 | 84.2 | 295 | 275.4 | 105.7 |
| 56 | 52.3 | 20.1 | 116 | 108.3 | 41.6 | 176 | 164.3 | 63.1 | 236 | 220.3 | 84.6 | 296 | 276.3 | 106.1 |
| 57 | 53.2 | 20.4 | 117 | 109.2 | 41.9 | 177 | 165.2 | 63.4 | 237 | 221.3 | 84.9 | 297 | 277.3 | 106.4 |
| 58 | 54.1 | 20.8 | 118 | 110.2 | 42.3 | 178 | 166.2 | 63.8 | 238 | 222.2 | 85.3 | 298 | 278.2 | 106.8 |
| 59 | 55.1 | 21.1 | 119 | 111.1 | 42.6 | 179 | 167.1 | 64.1 | 239 | 223.1 | 85.6 | 299 | 279.1 | 107.2 |
| 60 | 56.0 | 21.5 | 120 | 112.0 | 43.0 | 180 | 168.0 | 64.5 | 240 | 224.1 | 86.0 | 300 | 280.1 | 107.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 22 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 56.6 | 22.9 | 121 | 112.2 | 45.3 | 181 | 167.8 | 67.8 | 241 | 223.5 | 90.3 |
| 2 | 01.9 | 00.7 | 62 | 57.5 | 23.2 | 122 | 113.1 | 45.7 | 182 | 168.7 | 68.2 | 242 | 224.4 | 90.7 |
| 3 | 02.8 | 01.1 | 63 | 58.4 | 23.6 | 123 | 114.0 | 46.1 | 183 | 169.7 | 68.6 | 243 | 225.3 | 91.0 |
| 4 | 03.7 | 01.5 | 64 | 59.3 | 24.0 | 124 | 115.0 | 46.5 | 184 | 170.6 | 68.9 | 244 | 226.2 | 91.4 |
| 5 | 04.6 | 01.9 | 65 | 60.3 | 24.3 | 125 | 115.9 | 46.8 | 185 | 171.5 | 69.3 | 245 | 227.2 | 91.8 |
| 6 | 05.6 | 02.2 | 66 | 61.2 | 24.7 | 126 | 116.8 | 47.2 | 186 | 172.5 | 69.7 | 246 | 228.1 | 92.2 |
| 7 | 06.5 | 02.6 | 67 | 62.1 | 25.1 | 127 | 117.8 | 47.6 | 187 | 173.4 | 70.1 | 247 | 229.0 | 92.5 |
| 8 | 07.4 | 03.0 | 68 | 63.0 | 25.5 | 128 | 118.7 | 47.9 | 188 | 174.3 | 70.4 | 248 | 229.9 | 92.9 |
| 9 | 08.3 | 03.4 | 69 | 64.0 | 25.8 | 129 | 119.6 | 48.3 | 189 | 175.2 | 70.8 | 249 | 230.9 | 93.3 |
| 10 | 09.3 | 03.7 | 70 | 64.9 | 26.2 | 130 | 120.5 | 48.7 | 190 | 176.2 | 71.2 | 250 | 231.8 | 93.7 |
| 11 | 10.2 | 04.1 | 71 | 65.8 | 26.6 | 131 | 121.5 | 49.1 | 191 | 177.1 | 71.5 | 251 | 232.7 | 94.0 |
| 12 | 11.1 | 04.5 | 72 | 66.8 | 27.0 | 132 | 122.4 | 49.4 | 192 | 178.0 | 71.9 | 252 | 233.7 | 94.4 |
| 13 | 12.1 | 04.9 | 73 | 67.7 | 27.3 | 133 | 123.3 | 49.8 | 193 | 178.9 | 72.3 | 253 | 234.6 | 94.8 |
| 14 | 13.0 | 05.2 | 74 | 68.6 | 27.7 | 134 | 124.2 | 50.2 | 194 | 179.9 | 72.7 | 254 | 235.5 | 95.2 |
| 15 | 13.9 | 05.6 | 75 | 69.5 | 28.1 | 135 | 125.2 | 50.6 | 195 | 180.8 | 73.0 | 255 | 236.4 | 95.5 |
| 16 | 14.8 | 06.0 | 76 | 70.5 | 28.5 | 136 | 126.1 | 50.9 | 196 | 181.7 | 73.4 | 256 | 237.4 | 95.9 |
| 17 | 15.8 | 06.4 | 77 | 71.4 | 28.8 | 137 | 127.0 | 51.3 | 197 | 182.7 | 73.8 | 257 | 238.3 | 96.3 |
| 18 | 16.7 | 06.7 | 78 | 72.3 | 29.2 | 138 | 128.0 | 51.7 | 198 | 183.6 | 74.2 | 258 | 239.2 | 96.6 |
| 19 | 17.6 | 07.1 | 79 | 73.2 | 29.6 | 139 | 128.9 | 52.1 | 199 | 184.5 | 74.5 | 259 | 240.1 | 97.0 |
| 20 | 18.5 | 07.5 | 80 | 74.2 | 30.0 | 140 | 129.8 | 52.4 | 200 | 185.4 | 74.9 | 260 | 241.1 | 97.4 |
| 21 | 19.5 | 07.9 | 81 | 75.1 | 30.3 | 141 | 130.7 | 52.8 | 201 | 186.4 | 75.3 | 261 | 242.0 | 97.8 |
| 22 | 20.4 | 08.2 | 82 | 76.0 | 30.7 | 142 | 131.7 | 53.2 | 202 | 187.3 | 75.7 | 262 | 242.9 | 98.1 |
| 23 | 21.3 | 08.6 | 83 | 77.0 | 31.1 | 143 | 132.6 | 53.6 | 203 | 188.2 | 76.0 | 263 | 243.8 | 98.5 |
| 24 | 22.3 | 09.0 | 84 | 77.9 | 31.5 | 144 | 133.5 | 53.9 | 204 | 189.1 | 76.4 | 264 | 244.8 | 98.9 |
| 25 | 23.2 | 09.4 | 85 | 78.8 | 31.8 | 145 | 134.4 | 54.3 | 205 | 190.1 | 76.8 | 265 | 245.7 | 99.3 |
| 26 | 24.1 | 09.7 | 86 | 79.7 | 32.2 | 146 | 135.4 | 54.7 | 206 | 191.0 | 77.2 | 266 | 246.6 | 99.6 |
| 27 | 25.0 | 10.1 | 87 | 80.7 | 32.6 | 147 | 136.3 | 55.1 | 207 | 191.9 | 77.5 | 267 | 247.6 | 100.0 |
| 28 | 26.0 | 10.5 | 88 | 81.6 | 33.0 | 148 | 137.2 | 55.4 | 208 | 192.9 | 77.9 | 268 | 248.5 | 100.4 |
| 29 | 26.9 | 10.9 | 89 | 82.5 | 33.3 | 149 | 138.2 | 55.8 | 209 | 193.8 | 78.3 | 269 | 249.4 | 100.8 |
| 30 | 27.8 | 11.2 | 90 | 83.4 | 33.7 | 150 | 139.1 | 56.2 | 210 | 194.7 | 78.7 | 270 | 250.3 | 101.1 |
| 31 | 28.7 | 11.6 | 91 | 84.4 | 34.1 | 151 | 140.0 | 56.6 | 211 | 195.6 | 79.0 | 271 | 251.3 | 101.5 |
| 32 | 29.7 | 12.0 | 92 | 85.3 | 34.5 | 152 | 140.9 | 56.9 | 212 | 196.6 | 79.4 | 272 | 252.2 | 101.9 |
| 33 | 30.6 | 12.4 | 93 | 86.2 | 34.8 | 153 | 141.9 | 57.3 | 213 | 197.5 | 79.8 | 273 | 253.1 | 102.3 |
| 34 | 31.5 | 12.7 | 94 | 87.2 | 35.2 | 154 | 142.8 | 57.7 | 214 | 198.4 | 80.2 | 274 | 254.0 | 102.6 |
| 35 | 32.5 | 13.1 | 95 | 88.1 | 35.6 | 155 | 143.7 | 58.1 | 215 | 199.3 | 80.5 | 275 | 255.0 | 103.0 |
| 36 | 33.4 | 13.5 | 96 | 89.0 | 36.0 | 156 | 144.6 | 58.4 | 216 | 200.3 | 80.9 | 276 | 255.9 | 103.4 |
| 37 | 34.3 | 13.9 | 97 | 89.9 | 36.3 | 157 | 145.6 | 58.8 | 217 | 201.2 | 81.3 | 277 | 256.8 | 103.8 |
| 38 | 35.2 | 14.2 | 98 | 90.9 | 36.7 | 158 | 146.5 | 59.2 | 218 | 202.1 | 81.7 | 278 | 257.8 | 104.1 |
| 39 | 36.2 | 14.6 | 99 | 91.8 | 37.1 | 159 | 147.4 | 59.6 | 219 | 203.1 | 82.0 | 279 | 258.7 | 104.5 |
| 40 | 37.1 | 15.0 | 100 | 92.7 | 37.5 | 160 | 148.3 | 59.9 | 220 | 204.0 | 82.4 | 280 | 259.6 | 104.9 |
| 41 | 38.0 | 15.4 | 101 | 93.6 | 37.8 | 161 | 149.3 | 60.3 | 221 | 204.9 | 82.8 | 281 | 260.5 | 105.3 |
| 42 | 38.9 | 15.7 | 102 | 94.6 | 38.2 | 162 | 150.2 | 60.7 | 222 | 205.8 | 83.2 | 282 | 261.5 | 105.6 |
| 43 | 39.9 | 16.1 | 103 | 95.5 | 38.6 | 163 | 151.1 | 61.1 | 223 | 206.8 | 83.5 | 283 | 262.4 | 106.0 |
| 44 | 40.8 | 16.5 | 104 | 96.4 | 39.0 | 164 | 152.1 | 61.4 | 224 | 207.7 | 83.9 | 284 | 263.3 | 106.4 |
| 45 | 41.7 | 16.9 | 105 | 97.4 | 39.3 | 165 | 153.0 | 61.8 | 225 | 208.6 | 84.3 | 285 | 264.2 | 106.8 |
| 46 | 42.7 | 17.2 | 106 | 98.3 | 39.7 | 166 | 153.9 | 62.2 | 226 | 209.5 | 84.7 | 286 | 265.2 | 107.1 |
| 47 | 43.6 | 17.6 | 107 | 99.2 | 40.1 | 167 | 154.8 | 62.6 | 227 | 210.5 | 85.0 | 287 | 266.1 | 107.5 |
| 48 | 44.5 | 18.0 | 108 | 100.1 | 40.5 | 168 | 155.8 | 62.9 | 228 | 211.4 | 85.4 | 288 | 267.0 | 107.9 |
| 49 | 45.4 | 18.4 | 109 | 101.1 | 40.8 | 169 | 156.7 | 63.3 | 229 | 212.3 | 85.8 | 289 | 268.0 | 108.3 |
| 50 | 46.4 | 18.7 | 110 | 102.0 | 41.2 | 170 | 157.6 | 63.7 | 230 | 213.3 | 86.2 | 290 | 268.9 | 108.6 |
| 51 | 47.3 | 19.1 | 111 | 102.9 | 41.6 | 171 | 158.5 | 64.1 | 231 | 214.2 | 86.5 | 291 | 269.8 | 109.0 |
| 52 | 48.2 | 19.5 | 112 | 103.8 | 42.0 | 172 | 159.5 | 64.4 | 232 | 215.1 | 86.9 | 292 | 270.7 | 109.4 |
| 53 | 49.1 | 19.9 | 113 | 104.8 | 42.3 | 173 | 160.4 | 64.8 | 233 | 216.0 | 87.3 | 293 | 271.7 | 109.8 |
| 54 | 50.1 | 20.2 | 114 | 105.7 | 42.7 | 174 | 161.3 | 65.2 | 234 | 217.0 | 87.7 | 294 | 272.6 | 110.1 |
| 55 | 51.0 | 20.6 | 115 | 106.6 | 43.1 | 175 | 162.3 | 65.6 | 235 | 217.9 | 88.0 | 295 | 273.5 | 110.5 |
| 56 | 51.9 | 21.0 | 116 | 107.6 | 43.5 | 176 | 163.2 | 65.9 | 236 | 218.8 | 88.4 | 296 | 274.4 | 110.9 |
| 57 | 52.8 | 21.4 | 117 | 108.5 | 43.8 | 177 | 164.1 | 66.3 | 237 | 219.7 | 88.8 | 297 | 275.4 | 111.3 |
| 58 | 53.8 | 21.7 | 118 | 109.4 | 44.2 | 178 | 165.0 | 66.7 | 238 | 220.7 | 89.2 | 298 | 276.3 | 111.6 |
| 59 | 54.7 | 22.1 | 119 | 110.3 | 44.6 | 179 | 166.0 | 67.1 | 239 | 221.6 | 89.5 | 299 | 277.2 | 112.0 |
| 60 | 55.6 | 22.5 | 120 | 111.3 | 45.0 | 180 | 166.9 | 67.4 | 240 | 222.5 | 89.9 | 300 | 278.2 | 112.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

## Difference of Latitude and Departure for 23 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 56.2 | 23.8 | 121 | 111.4 | 47.3 | 181 | 166.6 | 70.7 | 241 | 221.8 | 94.2 |
| 2 | 01.8 | 00.8 | 62 | 57.1 | 24.2 | 122 | 112.3 | 47.7 | 182 | 167.5 | 71.1 | 242 | 222.8 | 94.5 |
| 3 | 02.8 | 01.2 | 63 | 58.0 | 24.6 | 123 | 113.2 | 48.1 | 183 | 168.5 | 71.5 | 243 | 223.7 | 94.9 |
| 4 | 03.7 | 01.6 | 64 | 58.9 | 25.0 | 124 | 114.1 | 48.5 | 184 | 169.4 | 71.9 | 244 | 224.6 | 95.3 |
| 5 | 04.6 | 02.0 | 65 | 59.8 | 25.4 | 125 | 115.1 | 48.8 | 185 | 170.3 | 72.3 | 245 | 225.5 | 95.7 |
| 6 | 05.5 | 02.3 | 66 | 60.8 | 25.8 | 126 | 116.0 | 49.2 | 186 | 171.2 | 72.7 | 246 | 226.4 | 96.1 |
| 7 | 06.4 | 02.7 | 67 | 61.7 | 26.2 | 127 | 116.9 | 49.6 | 187 | 172.1 | 73.1 | 247 | 227.4 | 96.5 |
| 8 | 07.4 | 03.1 | 68 | 62.6 | 26.6 | 128 | 117.8 | 50.0 | 188 | 173.1 | 73.5 | 248 | 228 3 | 96.9 |
| 9 | 08.3 | 03.5 | 69 | 63.5 | 27.0 | 129 | 118.7 | 50.4 | 189 | 174.0 | 73.8 | 249 | 229.2 | 97.3 |
| 10 | 09.2 | 03.9 | 70 | 64.4 | 27.4 | 130 | 119.7 | 50.8 | 190 | 174.9 | 74.2 | 250 | 230.1 | 97.7 |
| 11 | 10.1 | 04.3 | 71 | 65.4 | 27.7 | 131 | 120.6 | 51.2 | 191 | 175.8 | 74.6 | 251 | 231.0 | 98.1 |
| 12 | 11.0 | 04.7 | 72 | 66.3 | 28.1 | 132 | 121.5 | 51.6 | 192 | 176.7 | 75.0 | 252 | 232.0 | 98.5 |
| 13 | 12.0 | 05.1 | 73 | 67.2 | 28.5 | 133 | 122.4 | 52.0 | 193 | 177.7 | 75.4 | 253 | 232.9 | 98.9 |
| 14 | 12.9 | 05.5 | 74 | 68.1 | 28.9 | 134 | 123.3 | 52.4 | 194 | 178.6 | 75.8 | 254 | 233.8 | 99.2 |
| 15 | 13.8 | 05.9 | 75 | 69.0 | 29.3 | 135 | 124.3 | 52.7 | 195 | 179.5 | 76.2 | 255 | 234.7 | 99.6 |
| 16 | 14.7 | 06.3 | 76 | 70.0 | 29.7 | 136 | 125.2 | 53.1 | 196 | 180.4 | 76.6 | 256 | 235.6 | 100.0 |
| 17 | 15.6 | 06.6 | 77 | 70.9 | 30.1 | 137 | 126.1 | 53.5 | 197 | 181.3 | 77.0 | 257 | 236.6 | 100.4 |
| 18 | 16.6 | 07.0 | 78 | 71.8 | 30.5 | 138 | 127.0 | 53.9 | 198 | 182.3 | 77.4 | 258 | 237.5 | 100.8 |
| 19 | 17.5 | 07.4 | 79 | 72.7 | 30.9 | 139 | 128.0 | 54.3 | 199 | 183.2 | 77.8 | 259 | 238.4 | 101.2 |
| 20 | 18.4 | 07.8 | 80 | 73.6 | 31.3 | 140 | 128.9 | 54.7 | 200 | 184.1 | 78.1 | 260 | 239.3 | 101.6 |
| 21 | 19.3 | 08.2 | 81 | 74.6 | 31.6 | 141 | 129.8 | 55.1 | 201 | 185.0 | 78.5 | 261 | 240.3 | 102.0 |
| 22 | 20.3 | 08.6 | 82 | 75.5 | 32.0 | 142 | 130.7 | 55.5 | 202 | 185.9 | 78.9 | 262 | 241.2 | 102.4 |
| 23 | 21.2 | 09.0 | 83 | 76.4 | 32.4 | 143 | 131.6 | 55.9 | 203 | 186.9 | 79.3 | 263 | 242.1 | 102.8 |
| 24 | 22.1 | 09.4 | 84 | 77.3 | 32.8 | 144 | 132.6 | 56.3 | 204 | 187.8 | 79.7 | 264 | 243.0 | 103.2 |
| 25 | 23.0 | 09.8 | 85 | 78.2 | 33.2 | 145 | 133.5 | 56.7 | 205 | 188.7 | 80.1 | 265 | 243.9 | 103.5 |
| 26 | 23.9 | 10.2 | 86 | 79.2 | 33.6 | 146 | 134.4 | 57.0 | 206 | 189.6 | 80.5 | 266 | 244.9 | 103.9 |
| 27 | 24.9 | 10.5 | 87 | 80.1 | 34.0 | 147 | 135.3 | 57.4 | 207 | 190.5 | 80.9 | 267 | 245.8 | 104.3 |
| 28 | 25.8 | 10.9 | 88 | 81.0 | 34.4 | 148 | 136.2 | 57.8 | 208 | 191.5 | 81.3 | 268 | 246.7 | 104.7 |
| 29 | 26.7 | 11.3 | 89 | 81.9 | 34.8 | 149 | 137.2 | 58.2 | 209 | 192.4 | 81.7 | 269 | 247.6 | 105.1 |
| 30 | 27.6 | 11.7 | 90 | 82.8 | 35.2 | 150 | 138.1 | 58.6 | 210 | 193.3 | 82.1 | 270 | 248.5 | 105.5 |
| 31 | 28.5 | 12.1 | 91 | 83.8 | 35.6 | 151 | 139.0 | 59.0 | 211 | 194.2 | 82.4 | 271 | 249.5 | 105.9 |
| 32 | 29.5 | 12.5 | 92 | 84.7 | 35.9 | 152 | 139.9 | 59.4 | 212 | 195.1 | 82.8 | 272 | 250.4 | 106.3 |
| 33 | 30.4 | 12.9 | 93 | 85.6 | 36.3 | 153 | 140·8 | 59.8 | 213 | 196.1 | 83.2 | 273 | 251.3 | 106.7 |
| 34 | 31.3 | 13.3 | 94 | 86.5 | 36.7 | 154 | 141.8 | 60.2 | 214 | 197.0 | 83.6 | 274 | 252.2 | 107.1 |
| 35 | 32.2 | 13.7 | 95 | 87.4 | 37.1 | 155 | 142.7 | 60.6 | 215 | 197.9 | 84.0 | 275 | 253.1 | 107.5 |
| 36 | 33.1 | 14.1 | 96 | 88.4 | 37.5 | 156 | 143.6 | 61.0 | 216 | 198.8 | 84.4 | 276 | 254.1 | 107.8 |
| 37 | 34.1 | 14.5 | 97 | 89.3 | 37.9 | 157 | 144.5 | 61.3 | 217 | 199.7 | 84.8 | 277 | 255.0 | 108.2 |
| 38 | 35.0 | 14.8 | 98 | 90.2 | 38.3 | 158 | 145.4 | 61.7 | 218 | 200.7 | 85.2 | 278 | 255.9 | 108.6 |
| 39 | 35.9 | 15.2 | 99 | 91.1 | 38.7 | 159 | 146.4 | 62.1 | 219 | 201.6 | 85.6 | 279 | 256.8 | 109.0 |
| 40 | 36.8 | 15.6 | 100 | 92.1 | 39.1 | 160 | 147.3 | 62.5 | 220 | 202.5 | 86.0 | 280 | 257.7 | 109.4 |
| 41 | 37.7 | 16.0 | 101 | 93.0 | 39.5 | 161 | 148.2 | 62.9 | 221 | 203.4 | 86.4 | 281 | 258.7 | 109.8 |
| 42 | 38.7 | 16.4 | 102 | 93.9 | 39.9 | 162 | 149.1 | 63.3 | 222 | 204.4 | 86.7 | 282 | 259.6 | 110.2 |
| 43 | 39.6 | 16.8 | 103 | 94.8 | 40.2 | 163 | 150.0 | 63.7 | 223 | 205.3 | 87.1 | 283 | 260.5 | 110.6 |
| 44 | 40.5 | 17.2 | 104 | 95.7 | 40.6 | 164 | 151.0 | 64.1 | 224 | 206.2 | 87.5 | 284 | 261.4 | 111.0 |
| 45 | 41.4 | 17.6 | 105 | 96.7 | 41.0 | 165 | 151.9 | 64.5 | 225 | 207.1 | 87.9 | 285 | 262.3 | 111.4 |
| 46 | 42.3 | 18.0 | 106 | 97.6 | 41.4 | 166 | 152.8 | 64.9 | 226 | 208.0 | 88.3 | 286 | 263.3 | 111.7 |
| 47 | 43.3 | 18.4 | 107 | 98.5 | 41.8 | 167 | 153.7 | 65.3 | 227 | 209.0 | 88.7 | 287 | 264.2 | 112.1 |
| 48 | 44.2 | 18.8 | 108 | 99.4 | 42.2 | 168 | 154.6 | 65.6 | 228 | 209.9 | 89.1 | 288 | 265.1 | 112.5 |
| 49 | 45.1 | 19.1 | 109 | 100.3 | 42.6 | 169 | 155.6 | 66.0 | 229 | 210.8 | 89.5 | 289 | 266.0 | 112.9 |
| 50 | 46.0 | 19.5 | 110 | 101.3 | 43.0 | 170 | 156.5 | 66.4 | 230 | 211.7 | 89.9 | 290 | 266.9 | 113.3 |
| 51 | 46.9 | 19.9 | 111 | 102.2 | 43.4 | 171 | 157.4 | 66.8 | 231 | 212.6 | 90.3 | 291 | 267.9 | 113.7 |
| 52 | 47.9 | 20.3 | 112 | 103.1 | 43.8 | 172 | 158.3 | 67.2 | 232 | 213.6 | 90.6 | 292 | 268.8 | 114.1 |
| 53 | 48.8 | 20.7 | 113 | 104.0 | 44.2 | 173 | 159.2 | 67.6 | 233 | 214.5 | 91.0 | 293 | 269.7 | 114.5 |
| 54 | 49.7 | 21.1 | 114 | 104.9 | 44.5 | 174 | 160.2 | 68.0 | 234 | 215.4 | 91.4 | 294 | 270.6 | 114.9 |
| 55 | 50.6 | 21.5 | 115 | 105.9 | 44.9 | 175 | 161.1 | 68.4 | 235 | 216.3 | 91.8 | 295 | 271.5 | 115.3 |
| 56 | 51.5 | 21.9 | 116 | 106.8 | 45.3 | 176 | 162.0 | 68.8 | 236 | 217.2 | 92.2 | 296 | 272.5 | 115.7 |
| 57 | 52.5 | 22.3 | 117 | 107.7 | 45.7 | 177 | 162.9 | 69.2 | 237 | 218.2 | 92.6 | 297 | 273.4 | 116.0 |
| 58 | 53.4 | 22.7 | 118 | 108.6 | 46.1 | 178 | 163.8 | 69.6 | 238 | 219.1 | 93.0 | 298 | 274.3 | 116.4 |
| 59 | 54.3 | 23.1 | 119 | 109.5 | 46.5 | 179 | 164.8 | 69.9 | 239 | 220.0 | 93.4 | 299 | 275.2 | 116.8 |
| 60 | 55.2 | 23.4 | 120 | 110.5 | 46.9 | 180 | 165.7 | 70.3 | 240 | 220.9 | 93.8 | 300 | 276.2 | 117.2 |

| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

For 67 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 24 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 55.7 | 24.8 | 121 | 110.5 | 49.2 | 181 | 165.4 | 73.6 | 241 | 220.2 | 98.0 |
| 2 | 01.8 | 00.8 | 62 | 56.6 | 25.2 | 122 | 111.5 | 49.6 | 182 | 166.3 | 74.0 | 242 | 221.1 | 98.4 |
| 3 | 02.7 | 01.2 | 63 | 57.6 | 25.6 | 123 | 112.4 | 50.0 | 183 | 167.2 | 74.4 | 243 | 222.0 | 98.8 |
| 4 | 03.7 | 01.6 | 64 | 58.5 | 26.0 | 124 | 113.3 | 50.4 | 184 | 168.1 | 74.8 | 244 | 222.9 | 99.2 |
| 5 | 04.6 | 02.0 | 65 | 59.4 | 26.4 | 125 | 114.2 | 50.8 | 185 | 169.0 | 75.2 | 245 | 223.8 | 99.7 |
| 6 | 05.5 | 02.4 | 66 | 60.3 | 26.8 | 126 | 115.1 | 51.2 | 186 | 169.9 | 75.7 | 246 | 224.7 | 100.1 |
| 7 | 06.4 | 02.8 | 67 | 61.2 | 27.3 | 127 | 116.0 | 51.7 | 187 | 170.8 | 76.1 | 247 | 225.6 | 100.5 |
| 8 | 07.3 | 03.3 | 68 | 62.1 | 27.7 | 128 | 116.9 | 52.1 | 188 | 171.7 | 76.5 | 248 | 226.6 | 100.9 |
| 9 | 08.2 | 03.7 | 69 | 63.0 | 28.1 | 129 | 117.8 | 52.5 | 189 | 172.7 | 76.9 | 249 | 227.5 | 101.3 |
| 10 | 09.1 | 04.1 | 70 | 63.9 | 28.5 | 130 | 118.8 | 52.9 | 190 | 173.6 | 77.3 | 250 | 228.4 | 101.7 |
| 11 | 10.0 | 04.5 | 71 | 64.9 | 28.9 | 131 | 119.7 | 53.3 | 191 | 174.5 | 77.7 | 251 | 229.3 | 102.1 |
| 12 | 11.0 | 04·9 | 72 | 65.8 | 29.3 | 132 | 120.6 | 53.7 | 192 | 175.4 | 78.1 | 252 | 230.2 | 102.5 |
| 13 | 11.9 | 05.3 | 73 | 66.7 | 29.7 | 133 | 121.5 | 54.1 | 193 | 176.3 | 78.5 | 253 | 231.1 | 102.9 |
| 14 | 12.8 | 05.7 | 74 | 67.6 | 30.1 | 134 | 122.4 | 54.5 | 194 | 177.2 | 78.9 | 254 | 232.0 | 103.3 |
| 15 | 13.7 | 06.1 | 75 | 68.5 | 30.5 | 135 | 123.3 | 54.9 | 195 | 178.1 | 79.3 | 255 | 233.0 | 103.7 |
| 16 | 14.6 | 06.5 | 76 | 69.4 | 30.9 | 136 | 124.2 | 55.3 | 196 | 179.1 | 79.7 | 256 | 233.9 | 104.1 |
| 17 | 15.5 | 06.9 | 77 | 70.3 | 31.3 | 137 | 125.2 | 55.7 | 197 | 180.0 | 80.1 | 257 | 234.8 | 104.5 |
| 18 | 16.4 | 07.3 | 78 | 71.3 | 31.7 | 138 | 126.1 | 56.1 | 198 | 180.9 | 80.5 | 258 | 235.7 | 104.9 |
| 19 | 17.4 | 07.7 | 79 | 72.2 | 32.1 | 139 | 127.0 | 56.5 | 199 | 181.8 | 80.9 | 259 | 236.6 | 105.3 |
| 20 | 18.3 | 08.1 | 80 | 73.1 | 32.5 | 140 | 127.9 | 56.9 | 200 | 182.7 | 81.3 | 260 | 237.5 | 105.8 |
| 21 | 19.2 | 08.5 | 81 | 74.0 | 32.9 | 141 | 128.8 | 57.3 | 201 | 183.6 | 81.8 | 261 | 238.4 | 106.2 |
| 22 | 20.1 | 08.9 | 82 | 74.9 | 33.4 | 142 | 129.7 | 57.8 | 202 | 184.5 | 82.2 | 262 | 239.3 | 106.6 |
| 23 | 21.0 | 09.4 | 83 | 75.8 | 33.8 | 143 | 130.6 | 58.2 | 203 | 185.4 | 82.6 | 263 | 240.3 | 107.0 |
| 24 | 21.9 | 09.8 | 84 | 76.7 | 34.2 | 144 | 131.6 | 58.6 | 204 | 186.4 | 83.0 | 264 | 241.2 | 107.4 |
| 25 | 22.8 | 10.2 | 85 | 77.7 | 34.6 | 145 | 132.5 | 59.0 | 205 | 187.3 | 83.4 | 265 | 242.1 | 107.8 |
| 26 | 23.8 | 10.6 | 86 | 78.6 | 35.0 | 146 | 133.4 | 59.4 | 206 | 188.2 | 83.8 | 266 | 243.0 | 108.2 |
| 27 | 24.7 | 11.0 | 87 | 79.5 | 35.4 | 147 | 134.3 | 59.8 | 207 | 189.1 | 84.2 | 267 | 243.9 | 108.6 |
| 28 | 25.6 | 11.4 | 88 | 80.4 | 35.8 | 148 | 135.2 | 60.2 | 208 | 190.0 | 84.6 | 268 | 244.8 | 109.0 |
| 29 | 26.5 | 11.8 | 89 | 81.3 | 36.2 | 149 | 136.1 | 60.6 | 209 | 190.9 | 85.0 | 269 | 245.7 | 109.4 |
| 30 | 27.4 | 12.2 | 90 | 82.2 | 36.6 | 150 | 137.0 | 61.0 | 210 | 191.8 | 85.4 | 270 | 246.7 | 109.8 |
| 31 | 28.3 | 12.6 | 91 | 83.1 | 37.0 | 151 | 137.9 | 61.4 | 211 | 192.8 | 85.8 | 271 | 247.6 | 110.2 |
| 32 | 29.2 | 13.0 | 92 | 84.0 | 37.4 | 152 | 138.9 | 61.8 | 212 | 193.7 | 86.2 | 272 | 248.5 | 110.6 |
| 33 | 30.1 | 13.4 | 93 | 85.0 | 37.8 | 153 | 139.8 | 62.2 | 213 | 194.6 | 86.6 | 273 | 249.4 | 111.0 |
| 34 | 31.1 | 13.8 | 94 | 85.9 | 38.2 | 154 | 140.7 | 62.6 | 214 | 195.5 | 87.0 | 274 | 250.3 | 111.4 |
| 35 | 32.0 | 14.2 | 95 | 86.8 | 38.6 | 155 | 141.6 | 63.0 | 215 | 196.4 | 87.4 | 275 | 251.2 | 111.9 |
| 36 | 32.9 | 14.6 | 96 | 87.7 | 39.0 | 156 | 142.5 | 63.5 | 216 | 197.3 | 87.9 | 276 | 252.1 | 112.3 |
| 37 | 33.8 | 15.0 | 97 | 88.6 | 39.5 | 157 | 143.4 | 63.9 | 217 | 198.2 | 88.3 | 277 | 253.1 | 112.7 |
| 38 | 34.7 | 15.5 | 98 | 89.5 | 39.9 | 158 | 144.3 | 64.3 | 218 | 199.2 | 88.7 | 278 | 254.0 | 113.1 |
| 39 | 35.6 | 15.9 | 99 | 90.4 | 40.3 | 159 | 145.3 | 64.7 | 219 | 200.1 | 89.1 | 279 | 254.9 | 113.5 |
| 40 | 36.5 | 16.3 | 100 | 91.4 | 40.7 | 160 | 146.2 | 65.1 | 220 | 201.0 | 89.5 | 280 | 255.8 | 113.9 |
| 41 | 37.5 | 16.7 | 101 | 92.3 | 41.1 | 161 | 147.1 | 65.5 | 221 | 201.9 | 89.9 | 281 | 256.7 | 114.3 |
| 42 | 38.4 | 17.1 | 102 | 93.2 | 41.5 | 162 | 148.0 | 65.9 | 222 | 202.8 | 90.3 | 282 | 257.6 | 114.7 |
| 43 | 39.3 | 17.5 | 103 | 94.1 | 41.9 | 163 | 148.9 | 66.3 | 223 | 203.7 | 90.7 | 283 | 258.5 | 115.1 |
| 44 | 40.2 | 17.9 | 104 | 95.0 | 42.3 | 164 | 149.8 | 66.7 | 224 | 204.6 | 91.1 | 284 | 259.4 | 115.5 |
| 45 | 41.1 | 18.3 | 105 | 95.9 | 42.7 | 165 | 150.7 | 67.1 | 225 | 205.5 | 91.5 | 285 | 260.4 | 115.9 |
| 46 | 42.0 | 18.7 | 106 | 96.8 | 43.1 | 166 | 151.6 | 67.5 | 226 | 206.5 | 91.9 | 286 | 261.3 | 116.3 |
| 47 | 42.9 | 19.1 | 107 | 97.7 | 43.5 | 167 | 152.6 | 67.9 | 227 | 207.4 | 92.3 | 287 | 262.2 | 116.7 |
| 48 | 43.9 | 19.5 | 108 | 98.7 | 43.9 | 168 | 153.5 | 68.3 | 228 | 208.3 | 92.7 | 288 | 263.1 | 117.1 |
| 49 | 44.8 | 19.9 | 109 | 99.6 | 44.3 | 169 | 154.4 | 68.7 | 229 | 209.2 | 93.1 | 289 | 264.0 | 117.5 |
| 50 | 45.7 | 20.3 | 110 | 100.5 | 44.7 | 170 | 155.3 | 69.1 | 230 | 210.1 | 93.5 | 290 | 264.9 | 118.0 |
| 51 | 46.6 | 20.7 | 111 | 101.4 | 45.1 | 171 | 156.2 | 69.6 | 231 | 211.0 | 94.0 | 291 | 265.8 | 118.4 |
| 52 | 47.5 | 21.2 | 112 | 102.3 | 45.6 | 172 | 157.1 | 70.0 | 232 | 211.9 | 94.4 | 292 | 266.8 | 118.8 |
| 53 | 48.4 | 21.6 | 113 | 103.2 | 46.0 | 173 | 158.0 | 70.4 | 233 | 212.9 | 94.8 | 293 | 267.7 | 119.2 |
| 54 | 49.3 | 22.0 | 114 | 104.1 | 46.4 | 174 | 159.0 | 70.8 | 234 | 213.8 | 95.2 | 294 | 268.6 | 119.6 |
| 55 | 50.2 | 22.4 | 115 | 105.1 | 46.8 | 175 | 159.9 | 71.2 | 235 | 214.7 | 95.6 | 295 | 269.5 | 120.0 |
| 56 | 51.2 | 22.8 | 116 | 106.0 | 47.2 | 176 | 160.8 | 71.6 | 236 | 215.6 | 96.0 | 296 | 270.4 | 120.4 |
| 57 | 52.1 | 23.2 | 117 | 106.9 | 47.6 | 177 | 161.7 | 72.0 | 237 | 216.5 | 96.4 | 297 | 271.3 | 120.8 |
| 58 | 53.0 | 23.6 | 118 | 107.8 | 48.0 | 178 | 162.6 | 72.4 | 238 | 217.4 | 96.8 | 298 | 272.2 | 121.2 |
| 59 | 53.9 | 24.0 | 119 | 108.7 | 48.4 | 179 | 163.5 | 72.8 | 239 | 218.3 | 97.2 | 299 | 273.2 | 121.6 |
| 60 | 54.8 | 24.4 | 120 | 109.6 | 48.8 | 180 | 164.4 | 73.2 | 240 | 219.3 | 97.6 | 300 | 274.1 | 122.0 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 25 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 55.3 | 25.8 | 121 | 109.7 | 51.1 | 181 | 164.0 | 76.5 | 241 | 218.4 | 101.9 |
| 2 | 01.8 | 00.8 | 62 | 56.2 | 26.2 | 122 | 110.6 | 51.6 | 182 | 164.9 | 76.9 | 242 | 219.3 | 102.3 |
| 3 | 02.7 | 01.3 | 63 | 57.1 | 26.6 | 123 | 111.5 | 52.0 | 183 | 165.9 | 77.3 | 243 | 220.2 | 102.7 |
| 4 | 03.6 | 01.7 | 64 | 58.0 | 27.0 | 124 | 112.4 | 52.4 | 184 | 166.8 | 77.8 | 244 | 221.1 | 103.1 |
| 5 | 04.5 | 02.1 | 65 | 58.9 | 27.5 | 125 | 113.3 | 52.8 | 185 | 167.7 | 78.2 | 245 | 222.0 | 103.5 |
| 6 | 05.4 | 02.5 | 66 | 59.8 | 27.9 | 126 | 114.2 | 53.2 | 186 | 168.6 | 78.6 | 246 | 223.0 | 104.0 |
| 7 | 06.3 | 03.0 | 67 | 60.7 | 28.3 | 127 | 115.1 | 53.7 | 187 | 169.5 | 79.0 | 247 | 223.9 | 104.4 |
| 8 | 07.3 | 03.4 | 68 | 61.6 | 28.7 | 128 | 116.0 | 54.1 | 188 | 170.4 | 79.5 | 248 | 224.8 | 104.8 |
| 9 | 08.2 | 03.8 | 69 | 62.5 | 29.2 | 129 | 116.9 | 54.5 | 189 | 171.3 | 79.9 | 249 | 225.7 | 105.2 |
| 10 | 09.1 | 04.2 | 70 | 63.4 | 29.6 | 130 | 117.8 | 54.9 | 190 | 172.2 | 80.3 | 250 | 226.6 | 105.7 |
| 11 | 10.0 | 04.6 | 71 | 64.3 | 30.0 | 131 | 118.7 | 55.4 | 191 | 173.1 | 80.7 | 251 | 227.5 | 106.1 |
| 12 | 10.9 | 05.1 | 72 | 65.3 | 30.4 | 132 | 119.6 | 55.8 | 192 | 174.0 | 81.1 | 252 | 228.4 | 106.5 |
| 13 | 11.8 | 05.5 | 73 | 66.2 | 30.9 | 133 | 120.5 | 56.2 | 193 | 174.9 | 81.6 | 253 | 229.3 | 106.9 |
| 14 | 12.7 | 05.9 | 74 | 67.1 | 31.3 | 134 | 121.4 | 56.6 | 194 | 175.8 | 82.0 | 254 | 230.2 | 107.3 |
| 15 | 13.6 | 06.3 | 75 | 68.0 | 31.7 | 135 | 122.4 | 57.1 | 195 | 176.7 | 82.4 | 255 | 231.1 | 107.8 |
| 16 | 14.5 | 06.8 | 76 | 68.9 | 32.1 | 136 | 123.3 | 57.5 | 196 | 177.6 | 82.8 | 256 | 232.0 | 108.2 |
| 17 | 15.4 | 07.2 | 77 | 69.8 | 32.5 | 137 | 124.2 | 57.9 | 197 | 178.5 | 83.3 | 257 | 232.9 | 108.6 |
| 18 | 16.3 | 07.6 | 78 | 70.7 | 33.0 | 138 | 125.1 | 58.3 | 198 | 179.4 | 83.7 | 258 | 233.8 | 109.0 |
| 19 | 17.2 | 08.0 | 79 | 71.6 | 33.4 | 139 | 126.0 | 58.7 | 199 | 180.4 | 84.1 | 259 | 234.7 | 109.5 |
| 20 | 18.1 | 08.5 | 80 | 72.5 | 33.8 | 140 | 126.9 | 59.2 | 200 | 181.3 | 84.5 | 260 | 235.6 | 109.9 |
| 21 | 19.0 | 08.9 | 81 | 73.4 | 34.2 | 141 | 127.8 | 59.6 | 201 | 182.2 | 84.9 | 261 | 236.5 | 110.3 |
| 22 | 19.9 | 09.3 | 82 | 74.3 | 34.7 | 142 | 128.7 | 60.0 | 202 | 183.1 | 85.4 | 262 | 237.5 | 110.7 |
| 23 | 20.8 | 09.7 | 83 | 75.2 | 35.1 | 143 | 129.6 | 60.4 | 203 | 184.0 | 85.8 | 263 | 238.4 | 111.1 |
| 24 | 21.8 | 10.1 | 84 | 76.1 | 35.5 | 144 | 130.5 | 60.9 | 204 | 184.9 | 86.2 | 264 | 239.3 | 111.6 |
| 25 | 22.7 | 10.6 | 85 | 77.0 | 35.9 | 145 | 131.4 | 61.3 | 205 | 185.8 | 86.6 | 265 | 240.2 | 112.0 |
| 26 | 23.6 | 11.0 | 86 | 77.9 | 36.3 | 146 | 132.3 | 61.7 | 206 | 186.7 | 87.1 | 266 | 241.1 | 112.4 |
| 27 | 24.5 | 11.4 | 87 | 78.8 | 36.8 | 147 | 133.2 | 62.1 | 207 | 187.6 | 87.5 | 267 | 242.0 | 112.8 |
| 28 | 25.4 | 11.8 | 88 | 79.8 | 37.2 | 148 | 134.1 | 62.5 | 208 | 188.5 | 87.9 | 268 | 242.9 | 113.3 |
| 29 | 26.3 | 12.3 | 89 | 80.7 | 37.6 | 149 | 135.0 | 63.0 | 209 | 189.4 | 88.3 | 269 | 243.8 | 113.7 |
| 30 | 27.2 | 12.7 | 90 | 81.6 | 38.0 | 150 | 135.9 | 63.4 | 210 | 190.3 | 88.7 | 270 | 244.7 | 114.1 |
| 31 | 28.1 | 13.1 | 91 | 82.5 | 38.5 | 151 | 136.9 | 63.8 | 211 | 191.2 | 89.2 | 271 | 245.6 | 114.5 |
| 32 | 29.0 | 13.5 | 92 | 83.4 | 38.9 | 152 | 137.8 | 64.2 | 212 | 192.1 | 89.6 | 272 | 246.5 | 115.0 |
| 33 | 29.9 | 13.9 | 93 | 84.3 | 39.3 | 153 | 138·7 | 64.7 | 213 | 193.0 | 90.0 | 273 | 247.4 | 115.4 |
| 34 | 30.8 | 14.4 | 94 | 85.2 | 39.7 | 154 | 139.6 | 65.1 | 214 | 193.9 | 90.4 | 274 | 248.3 | 115.8 |
| 35 | 31.7 | 14.8 | 95 | 86.1 | 40.1 | 155 | 140.5 | 65.5 | 215 | 194.9 | 90.9 | 275 | 249.2 | 116.2 |
| 36 | 32.6 | 15.2 | 96 | 87.0 | 40.6 | 156 | 141.4 | 65.9 | 216 | 195.8 | 91.3 | 276 | 250.1 | 116.6 |
| 37 | 33.5 | 15.6 | 97 | 87.9 | 41.0 | 157 | 142.3 | 66.4 | 217 | 196.7 | 91.7 | 277 | 251.0 | 117.1 |
| 38 | 34.4 | 16.1 | 98 | 88.8 | 41.4 | 158 | 143.2 | 66.8 | 218 | 197.6 | 92.1 | 278 | 252.0 | 117.5 |
| 39 | 35.3 | 16.5 | 99 | 89.7 | 41.8 | 159 | 144.1 | 67.2 | 219 | 198.5 | 92.6 | 279 | 252.9 | 117.9 |
| 40 | 36.3 | 16.9 | 100 | 90.6 | 42.3 | 160 | 145.0 | 67.6 | 220 | 199.4 | 93.0 | 280 | 253.8 | 118.3 |
| 41 | 37.2 | 17.3 | 101 | 91.5 | 42.7 | 161 | 145.9 | 68.0 | 221 | 200.3 | 93.4 | 281 | 254.7 | 118.8 |
| 42 | 38.1 | 17.7 | 102 | 92.4 | 43.1 | 162 | 146.8 | 68.5 | 222 | 201.2 | 93.8 | 282 | 255.6 | 119.2 |
| 43 | 39.0 | 18.2 | 103 | 93.3 | 43.5 | 163 | 147.7 | 68.9 | 223 | 202.1 | 94.2 | 283 | 256.5 | 119.6 |
| 44 | 39.9 | 18.6 | 104 | 94.3 | 44.0 | 164 | 148.6 | 69.3 | 224 | 203.0 | 94.7 | 284 | 257.4 | 120.0 |
| 45 | 40.8 | 19.0 | 105 | 95.2 | 44.4 | 165 | 149.5 | 69.7 | 225 | 203.9 | 95.1 | 285 | 258.3 | 120.4 |
| 46 | 41.7 | 19.4 | 106 | 96.1 | 44.8 | 166 | 150.4 | 70.2 | 226 | 204.8 | 95.5 | 286 | 259.2 | 120.9 |
| 47 | 42.6 | 19.9 | 107 | 97.0 | 45.2 | 167 | 151.4 | 70.6 | 227 | 205.7 | 95.9 | 287 | 260.1 | 121.3 |
| 48 | 43.5 | 20.3 | 108 | 97.9 | 45.6 | 168 | 152.3 | 71.0 | 228 | 206.6 | 96.4 | 288 | 261.0 | 121.7 |
| 49 | 44.4 | 20.7 | 109 | 98.8 | 46.1 | 169 | 153.2 | 71.4 | 229 | 207.5 | 96.8 | 289 | 261.9 | 122.1 |
| 50 | 45.3 | 21.1 | 110 | 99.7 | 46.5 | 170 | 154.1 | 71.8 | 230 | 208.5 | 97.2 | 290 | 262.8 | 122.6 |
| 51 | 46.2 | 21 6 | 111 | 100.6 | 46.9 | 171 | 155.0 | 72.3 | 231 | 209.4 | 97.6 | 291 | 263.7 | 123.0 |
| 52 | 47.1 | 22.0 | 112 | 101.5 | 47.3 | 172 | 155.9 | 72.7 | 232 | 210.3 | 98.0 | 292 | 264.6 | 123.4 |
| 53 | 48.0 | 22.4 | 113 | 102.4 | 47.8 | 173 | 156.8 | 73.1 | 233 | 211.2 | 98.5 | 293 | 265.5 | 123.8 |
| 54 | 48.9 | 22.8 | 114 | 103.3 | 48.2 | 174 | 157.7 | 73.5 | 234 | 212.1 | 98.9 | 294 | 266.5 | 124.2 |
| 55 | 49.8 | 23.2 | 115 | 104.2 | 48.6 | 175 | 158.6 | 74.0 | 235 | 213.0 | 99.3 | 295 | 267.4 | 124.7 |
| 56 | 50.8 | 23.7 | 116 | 105.1 | 49.0 | 176 | 159.5 | 74.4 | 236 | 213.9 | 99.7 | 296 | 268.3 | 125.1 |
| 57 | 51.7 | 24.1 | 117 | 106.0 | 49.4 | 177 | 160.4 | 74.8 | 237 | 214.8 | 100.2 | 297 | 269.2 | 125.5 |
| 58 | 52.6 | 24.5 | 118 | 106.9 | 49.9 | 178 | 161.3 | 75.2 | 238 | 215.7 | 100.6 | 298 | 270.1 | 125.9 |
| 59 | 53.5 | 24.9 | 119 | 107.9 | 50.3 | 179 | 162.2 | 75.6 | 239 | 216.6 | 101.0 | 299 | 271.0 | 126.4 |
| 60 | 54.4 | 25.4 | 120 | 108.8 | 50.7 | 180 | 163.1 | 76.1 | 240 | 217.5 | 101.4 | 300 | 271.9 | 126.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 26 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.4 | 61 | 54.8 | 26.7 | 121 | 108.8 | 53.0 | 181 | 162.7 | 79.3 | 241 | 216.6 | 105.6 |
| 2 | 01.8 | 00.9 | 62 | 55.7 | 27.2 | 122 | 109.7 | 53.5 | 182 | 163.6 | 79.8 | 242 | 217.5 | 106.1 |
| 3 | 02.7 | 01.3 | 63 | 56.6 | 27.6 | 123 | 110.6 | 53.9 | 183 | 164.5 | 80.2 | 243 | 218.4 | 106.5 |
| 4 | 03.6 | 01.8 | 64 | 57.5 | 28.1 | 124 | 111.5 | 54.4 | 184 | 165.4 | 80.7 | 244 | 219.3 | 107.0 |
| 5 | 04.5 | 02.2 | 65 | 58.4 | 28.5 | 125 | 112.3 | 54.8 | 185 | 166.3 | 81.1 | 245 | 220.2 | 107.4 |
| 6 | 05.4 | 02.6 | 66 | 59.3 | 28.9 | 126 | 113.2 | 55.2 | 186 | 167.2 | 81.5 | 246 | 221.1 | 107.8 |
| 7 | 06.3 | 03.1 | 67 | 60.2 | 29.4 | 127 | 114.1 | 55.7 | 187 | 168.1 | 82.0 | 247 | 222.0 | 108.3 |
| 8 | 07.2 | 03.5 | 68 | 61.1 | 29.8 | 128 | 115.0 | 56.1 | 188 | 169.0 | 82.4 | 248 | 222.9 | 108.7 |
| 9 | 08.1 | 03.9 | 69 | 62.0 | 30.2 | 129 | 115.9 | 56.5 | 189 | 169.9 | 82.9 | 249 | 223.8 | 109.2 |
| 10 | 09.0 | 04.4 | 70 | 62.9 | 30.7 | 130 | 116.8 | 57.0 | 190 | 170.8 | 83.3 | 250 | 224.7 | 109.6 |
| 11 | 09.9 | 04.8 | 71 | 63.8 | 31.1 | 131 | 117.7 | 57.4 | 191 | 171.7 | 83.7 | 251 | 225.6 | 110.0 |
| 12 | 10.8 | 05.3 | 72 | 64.7 | 31.6 | 132 | 118.6 | 57.9 | 192 | 172.6 | 84.2 | 252 | 226.5 | 110.5 |
| 13 | 11.7 | 05.7 | 73 | 65.6 | 32.0 | 133 | 119.5 | 58.3 | 193 | 173.5 | 84.6 | 253 | 227.4 | 110.9 |
| 14 | 12.6 | 06.1 | 74 | 66.5 | 32.4 | 134 | 120.4 | 58.7 | 194 | 174.4 | 85.0 | 254 | 228.3 | 111.3 |
| 15 | 13.5 | 06.6 | 75 | 67.4 | 32.9 | 135 | 121.3 | 59.2 | 195 | 175.3 | 85.5 | 255 | 229.2 | 111.8 |
| 16 | 14.4 | 07.0 | 76 | 68.3 | 33.3 | 136 | 122.2 | 59.6 | 196 | 176.2 | 85.9 | 256 | 230.1 | 112.2 |
| 17 | 15.3 | 07.5 | 77 | 69.2 | 33.8 | 137 | 123.1 | 60.1 | 197 | 177.1 | 86.4 | 257 | 231.0 | 112.7 |
| 18 | 16.2 | 07.9 | 78 | 70.1 | 34.2 | 138 | 124.0 | 60.5 | 198 | 178.0 | 86.8 | 258 | 231.9 | 113.1 |
| 19 | 17.1 | 08.3 | 79 | 71.0 | 34.6 | 139 | 124.9 | 60.9 | 199 | 178.9 | 87.2 | 259 | 232.8 | 113.5 |
| 20 | 18.0 | 08.8 | 80 | 71.9 | 35.1 | 140 | 125.8 | 61.4 | 200 | 179.8 | 87.7 | 260 | 233.7 | 114.0 |
| 21 | 18.9 | 09.2 | 81 | 72.8 | 35.5 | 141 | 126.7 | 61.8 | 201 | 180.7 | 88.1 | 261 | 234.6 | 114.4 |
| 22 | 19.8 | 09.6 | 82 | 73.7 | 35.9 | 142 | 127.6 | 62.2 | 202 | 181.6 | 88.6 | 262 | 235.5 | 114.9 |
| 23 | 20.7 | 10.1 | 83 | 74.6 | 36.4 | 143 | 128.5 | 62.7 | 203 | 182.5 | 89.0 | 263 | 236.4 | 115.3 |
| 24 | 21.6 | 10.5 | 84 | 75.5 | 36.8 | 144 | 129.4 | 63.1 | 204 | 183.4 | 89.4 | 264 | 237.3 | 115.7 |
| 25 | 22.5 | 11.0 | 85 | 76.4 | 37.3 | 145 | 130.3 | 63.6 | 205 | 184.3 | 89.9 | 265 | 238.2 | 116.2 |
| 26 | 23.4 | 11.4 | 86 | 77.3 | 37.7 | 146 | 131.2 | 64.0 | 206 | 185.2 | 90.3 | 266 | 239.1 | 116.6 |
| 27 | 24.3 | 11.8 | 87 | 78.2 | 38.1 | 147 | 132.1 | 64.4 | 207 | 186.1 | 90.7 | 267 | 240.0 | 117.0 |
| 28 | 25.2 | 12.3 | 88 | 79.1 | 38.6 | 148 | 133.0 | 64.9 | 208 | 186.9 | 91.2 | 268 | 240.9 | 117.5 |
| 29 | 26.1 | 12.7 | 89 | 80.0 | 39.0 | 149 | 133.9 | 65.3 | 209 | 187.8 | 91.6 | 269 | 241.8 | 117.9 |
| 30 | 27.0 | 13.2 | 90 | 80.9 | 39.5 | 150 | 134.8 | 65.8 | 210 | 188.7 | 92.1 | 270 | 242.7 | 118.4 |
| 31 | 27.9 | 13.6 | 91 | 81.8 | 39.9 | 151 | 135.7 | 66.2 | 211 | 189.6 | 92.5 | 271 | 243.6 | 118.8 |
| 32 | 28.8 | 14.0 | 92 | 82.7 | 40.3 | 152 | 136.6 | 66.6 | 212 | 190.5 | 92.9 | 272 | 244.5 | 119.2 |
| 33 | 29.7 | 14.5 | 93 | 83.6 | 40.8 | 153 | 137.5 | 67.1 | 213 | 191.4 | 93.4 | 273 | 245.4 | 119.7 |
| 34 | 30.6 | 14.9 | 94 | 84.5 | 41.2 | 154 | 138.4 | 67.5 | 214 | 192.3 | 93.8 | 274 | 246.3 | 120.1 |
| 35 | 31.5 | 15.3 | 95 | 85.4 | 41.6 | 155 | 139.3 | 67.9 | 215 | 193.2 | 94.2 | 275 | 247.2 | 120.6 |
| 36 | 32.4 | 15.8 | 96 | 86.3 | 42.1 | 156 | 140.2 | 68.4 | 216 | 194.1 | 94.7 | 276 | 248.1 | 121.0 |
| 37 | 33.3 | 16.2 | 97 | 87.2 | 42.5 | 157 | 141.1 | 68.8 | 217 | 195.0 | 95.1 | 277 | 249.0 | 121.4 |
| 38 | 34.2 | 16.7 | 98 | 88.1 | 43.0 | 158 | 142.0 | 69.3 | 218 | 195.9 | 95.6 | 278 | 249.9 | 121.9 |
| 39 | 35.1 | 17.1 | 99 | 89.0 | 43.4 | 159 | 142.9 | 69.7 | 219 | 196.8 | 96.0 | 279 | 250.8 | 122.3 |
| 40 | 36.0 | 17.5 | 100 | 89.9 | 43.8 | 160 | 143.8 | 70.1 | 220 | 197.7 | 96.4 | 280 | 251.7 | 122.7 |
| 41 | 36.9 | 18.0 | 101 | 90.8 | 44.3 | 161 | 144.7 | 70.6 | 221 | 198.6 | 96.9 | 281 | 252.6 | 123.2 |
| 42 | 37.7 | 18.4 | 102 | 91.7 | 44.7 | 162 | 145.6 | 71.0 | 222 | 199.5 | 97.3 | 282 | 253.5 | 123.6 |
| 43 | 38.6 | 18.8 | 103 | 92.6 | 45.2 | 163 | 146.5 | 71.5 | 223 | 200.4 | 97.8 | 283 | 254.4 | 124.1 |
| 44 | 39.5 | 19.3 | 104 | 93.5 | 45.6 | 164 | 147.4 | 71.9 | 224 | 201.3 | 98.2 | 284 | 255.3 | 124.5 |
| 45 | 40.4 | 19.7 | 105 | 94.4 | 46.0 | 165 | 148.3 | 72.3 | 225 | 202.2 | 98.6 | 285 | 256.2 | 124.9 |
| 46 | 41.3 | 20.2 | 106 | 95.3 | 46.5 | 166 | 149.2 | 72.8 | 226 | 203.1 | 99.1 | 286 | 257.1 | 125.4 |
| 47 | 42.2 | 20.6 | 107 | 96.2 | 46.9 | 167 | 150.1 | 73.2 | 227 | 204.0 | 99.5 | 287 | 258.0 | 125.8 |
| 48 | 43.1 | 21.0 | 108 | 97.1 | 47.3 | 168 | 151.0 | 73.6 | 228 | 204.9 | 99.9 | 288 | 258.9 | 126.3 |
| 49 | 44.0 | 21.5 | 109 | 98.0 | 47.8 | 169 | 151.9 | 74.1 | 229 | 205.8 | 100.4 | 289 | 259.8 | 126.7 |
| 50 | 44.9 | 21.9 | 110 | 98.9 | 48.2 | 170 | 152.8 | 74.5 | 230 | 206.7 | 100.8 | 290 | 260.7 | 127.1 |
| 51 | 45.8 | 22.4 | 111 | 99.8 | 48.7 | 171 | 153.7 | 75.0 | 231 | 207.6 | 101.3 | 291 | 261.5 | 127.6 |
| 52 | 46.7 | 22.8 | 112 | 100.7 | 49.1 | 172 | 154.6 | 75.4 | 232 | 208.5 | 101.7 | 292 | 262.4 | 128.0 |
| 53 | 47.6 | 23.2 | 113 | 101.6 | 49.5 | 173 | 155.5 | 75.8 | 233 | 209.4 | 102.1 | 293 | 263.3 | 128.4 |
| 54 | 48.5 | 23.7 | 114 | 102.5 | 50.0 | 174 | 156.4 | 76.3 | 234 | 210.3 | 102.6 | 294 | 264.2 | 128.9 |
| 55 | 49.4 | 24.1 | 115 | 103.4 | 50.4 | 175 | 157.3 | 76.7 | 235 | 211.2 | 103.0 | 295 | 265.1 | 129.3 |
| 56 | 50.3 | 24.5 | 116 | 104.3 | 50.9 | 176 | 158.2 | 77.2 | 236 | 212.1 | 103.5 | 296 | 266.0 | 129.8 |
| 57 | 51.2 | 25.0 | 117 | 105.2 | 51.3 | 177 | 159.1 | 77.6 | 237 | 213.0 | 103.9 | 297 | 266.9 | 130.2 |
| 58 | 52.1 | 25.4 | 118 | 106.1 | 51.7 | 178 | 160.0 | 78.0 | 238 | 213.9 | 104.3 | 298 | 267.8 | 130.6 |
| 59 | 53.0 | 25.9 | 119 | 107.0 | 52.2 | 179 | 160.9 | 78.5 | 239 | 214.8 | 104.8 | 299 | 268.7 | 131.1 |
| 60 | 53.9 | 26.3 | 120 | 107.9 | 52.6 | 180 | 161.8 | 78.9 | 240 | 215.7 | 105.2 | 300 | 269.6 | 131.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

## Difference of Latitude and Departure for 27 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.5 | 61 | 54.4 | 27.7 | 121 | 107.8 | 54.9 | 181 | 161.3 | 82.2 | 241 | 214.7 | 109.4 |
| 2 | 01.8 | 00.9 | 62 | 55.2 | 28.1 | 122 | 108.7 | 55.4 | 182 | 162.2 | 82.6 | 242 | 215.6 | 109.9 |
| 3 | 02.7 | 01.4 | 63 | 56.1 | 28.6 | 123 | 109.6 | 55.8 | 183 | 163.1 | 83.1 | 243 | 216.5 | 110.3 |
| 4 | 03.6 | 01.8 | 64 | 57.0 | 29.1 | 124 | 110.5 | 56.3 | 184 | 163.9 | 83.5 | 244 | 217.4 | 110.8 |
| 5 | 04.5 | 02.3 | 65 | 57.9 | 29.5 | 125 | 111.4 | 56.7 | 185 | 164.8 | 84.0 | 245 | 218.3 | 111.2 |
| 6 | 05.3 | 02.7 | 66 | 58.8 | 30.0 | 126 | 112.3 | 57.2 | 186 | 165.7 | 84.4 | 246 | 219.2 | 111.7 |
| 7 | 06.2 | 03.2 | 67 | 59.7 | 30.4 | 127 | 113.2 | 57.7 | 187 | 166.6 | 84.9 | 247 | 220.1 | 112.1 |
| 8 | 07.1 | 03.6 | 68 | 60.6 | 30.9 | 128 | 114.0 | 58.1 | 188 | 167.5 | 85.4 | 248 | 221.0 | 112.6 |
| 9 | 08.0 | 04.1 | 69 | 61.5 | 31.3 | 129 | 114.9 | 58.6 | 189 | 168.4 | 85.8 | 249 | 221.9 | 113.0 |
| 10 | 08.9 | 04.5 | 70 | 62.4 | 31.8 | 130 | 115.8 | 59.0 | 190 | 169.3 | 86.3 | 250 | 222.8 | 113.5 |
| 11 | 09.8 | 05.0 | 71 | 63.3 | 32.2 | 131 | 116.7 | 59.5 | 191 | 170.2 | 86.7 | 251 | 223.6 | 114.0 |
| 12 | 10.7 | 05.4 | 72 | 64.2 | 32.7 | 132 | 117.6 | 59.9 | 192 | 171.1 | 87.2 | 252 | 224.5 | 114.4 |
| 13 | 11.6 | 05.9 | 73 | 65.0 | 33.1 | 133 | 118.5 | 60.4 | 193 | 172.0 | 87.6 | 253 | 225.4 | 114.9 |
| 14 | 12.5 | 06.4 | 74 | 65.9 | 33.6 | 134 | 119.4 | 60.8 | 194 | 172.9 | 88.1 | 254 | 226.3 | 115.3 |
| 15 | 13.4 | 06.8 | 75 | 66.8 | 34.0 | 135 | 120.3 | 61.3 | 195 | 173.7 | 88.5 | 255 | 227.2 | 115.8 |
| 16 | 14.3 | 07.3 | 76 | 67.7 | 34.5 | 136 | 121.2 | 61.7 | 196 | 174.6 | 89.0 | 256 | 228.1 | 116.2 |
| 17 | 15.1 | 07.7 | 77 | 68.6 | 35.0 | 137 | 122.1 | 62.2 | 197 | 175.5 | 89.4 | 257 | 229.0 | 116.7 |
| 18 | 16.0 | 08.2 | 78 | 69.5 | 35.4 | 138 | 123.0 | 62.7 | 198 | 176.4 | 89.9 | 258 | 229.9 | 117.1 |
| 19 | 16.9 | 08.6 | 79 | 70.4 | 35.9 | 139 | 123.8 | 63.1 | 199 | 177.3 | 90.3 | 259 | 230.8 | 117.6 |
| 20 | 17.8 | 09.1 | 80 | 71.3 | 36.3 | 140 | 124.7 | 63.6 | 200 | 178.2 | 90.8 | 260 | 231.7 | 118.0 |
| 21 | 18.7 | 09.5 | 81 | 72.2 | 36.8 | 141 | 125.6 | 64.0 | 201 | 179.1 | 91.3 | 261 | 232.6 | 118.5 |
| 22 | 19.6 | 10.0 | 82 | 73.1 | 37.2 | 142 | 126.5 | 64.5 | 202 | 180.0 | 91.7 | 262 | 233.4 | 118.9 |
| 23 | 20.5 | 10.4 | 83 | 74.0 | 37.7 | 143 | 127.4 | 64.9 | 203 | 180.9 | 92.2 | 263 | 234.3 | 119.4 |
| 24 | 21.4 | 10.9 | 84 | 74.8 | 38.1 | 144 | 128.3 | 65.4 | 204 | 181.8 | 92.6 | 264 | 235.2 | 119.9 |
| 25 | 22.3 | 11.3 | 85 | 75.7 | 38.6 | 145 | 129.2 | 65.8 | 205 | 182.7 | 93.1 | 265 | 236.1 | 120.3 |
| 26 | 23.2 | 11.8 | 86 | 76.6 | 39.0 | 146 | 130.1 | 66.3 | 206 | 183.5 | 93.5 | 266 | 237.0 | 120.8 |
| 27 | 24.1 | 12.3 | 87 | 77.5 | 39.5 | 147 | 131.0 | 66.7 | 207 | 184.4 | 94.0 | 267 | 237.9 | 121.2 |
| 28 | 24.9 | 12.7 | 88 | 78.4 | 40.0 | 148 | 131.9 | 67.2 | 208 | 185.3 | 94.4 | 268 | 238.8 | 121.7 |
| 29 | 25.8 | 13.2 | 89 | 79.3 | 40.4 | 149 | 132.8 | 67.6 | 209 | 186.2 | 94.9 | 269 | 239.7 | 122.1 |
| 30 | 26.7 | 13.6 | 90 | 80.2 | 40.9 | 150 | 133.7 | 68.1 | 210 | 187.1 | 95.3 | 270 | 240.6 | 122.6 |
| 31 | 27.6 | 14.1 | 91 | 81.1 | 41.3 | 151 | 134.5 | 68.6 | 211 | 188.0 | 95.8 | 271 | 241.5 | 123.0 |
| 32 | 28.5 | 14.5 | 92 | 82.0 | 41.8 | 152 | 135.4 | 69.0 | 212 | 188.9 | 96.2 | 272 | 242.4 | 123.5 |
| 33 | 29.4 | 15.0 | 93 | 82.9 | 42.2 | 153 | 136.3 | 69.5 | 213 | 189.8 | 96.7 | 273 | 243.2 | 123.9 |
| 34 | 30.3 | 15.4 | 94 | 83.8 | 42.7 | 154 | 137.2 | 69.9 | 214 | 190.7 | 97.2 | 274 | 244.1 | 124.4 |
| 35 | 31.2 | 15.9 | 95 | 84.6 | 43.1 | 155 | 138.1 | 70.4 | 215 | 191.6 | 97.6 | 275 | 245.0 | 124.8 |
| 36 | 32.1 | 16.3 | 96 | 85.5 | 43.6 | 156 | 139.0 | 70.8 | 216 | 192.5 | 98.1 | 276 | 245.9 | 125.3 |
| 37 | 33.0 | 16.8 | 97 | 86.4 | 44.0 | 157 | 139.9 | 71.3 | 217 | 193.3 | 98.5 | 277 | 246.8 | 125.8 |
| 38 | 33.9 | 17.3 | 98 | 87.3 | 44.5 | 158 | 140.8 | 71.7 | 218 | 194.2 | 99.0 | 278 | 247.7 | 126.2 |
| 39 | 34.7 | 17.7 | 99 | 88.2 | 44.9 | 159 | 141.7 | 72.2 | 219 | 195.1 | 99.4 | 279 | 248.6 | 126.7 |
| 40 | 35.6 | 18.2 | 100 | 89.1 | 45.4 | 160 | 142.6 | 72.6 | 220 | 196.0 | 99.9 | 280 | 249.5 | 127.1 |
| 41 | 36.5 | 18.6 | 101 | 90.0 | 45.9 | 161 | 143.5 | 73.1 | 221 | 196.9 | 100.3 | 281 | 250.4 | 127.6 |
| 42 | 37.4 | 19.1 | 102 | 90.9 | 46.3 | 162 | 144.3 | 73.5 | 222 | 197.8 | 100.8 | 282 | 251.3 | 128.0 |
| 43 | 38.3 | 19.5 | 103 | 91.8 | 46.8 | 163 | 145.2 | 74.0 | 223 | 198.7 | 101.2 | 283 | 252.2 | 128.5 |
| 44 | 39.2 | 20.0 | 104 | 92.7 | 47.2 | 164 | 146.1 | 74.5 | 224 | 199.6 | 101.7 | 284 | 253.0 | 128.9 |
| 45 | 40.1 | 20.4 | 105 | 93.6 | 47.7 | 165 | 147.0 | 74.9 | 225 | 200.5 | 102.1 | 285 | 253.9 | 129.4 |
| 46 | 41.0 | 20.9 | 106 | 94.4 | 48.1 | 166 | 147.9 | 75.4 | 226 | 201.4 | 102.6 | 286 | 254.8 | 129.8 |
| 47 | 41.9 | 21.3 | 107 | 95.3 | 48.6 | 167 | 148.8 | 75.8 | 227 | 202.3 | 103.1 | 287 | 255.7 | 130.3 |
| 48 | 42.8 | 21.8 | 108 | 96.2 | 49.0 | 168 | 149.7 | 76.3 | 228 | 203.1 | 103.5 | 288 | 256.6 | 130.7 |
| 49 | 43.7 | 22.2 | 109 | 97.1 | 49.5 | 169 | 150.6 | 76.7 | 229 | 204.0 | 104.0 | 289 | 257.5 | 131.2 |
| 50 | 44.6 | 22.7 | 110 | 98.0 | 49.9 | 170 | 151.5 | 77.2 | 230 | 204.9 | 104.4 | 290 | 258.4 | 131.7 |
| 51 | 45.4 | 23.2 | 111 | 98.9 | 50.4 | 171 | 152.4 | 77.6 | 231 | 205.8 | 104.9 | 291 | 259.3 | 132.1 |
| 52 | 46.3 | 23.6 | 112 | 99.8 | 50.8 | 172 | 153.3 | 78.1 | 232 | 206.7 | 105.3 | 292 | 260.2 | 132.6 |
| 53 | 47.2 | 24.1 | 113 | 100.7 | 51.3 | 173 | 154.1 | 78.5 | 233 | 207.6 | 105.8 | 293 | 261.1 | 133.0 |
| 54 | 48.1 | 24.5 | 114 | 101.6 | 51.8 | 174 | 155.0 | 79.0 | 234 | 208.5 | 106.2 | 294 | 262.0 | 133.5 |
| 55 | 49.0 | 25.0 | 115 | 102.5 | 52.2 | 175 | 155.9 | 79.4 | 235 | 209.4 | 106.7 | 295 | 262.8 | 133.9 |
| 56 | 49.9 | 25.4 | 116 | 103.4 | 52.7 | 176 | 156.8 | 79.9 | 236 | 210.3 | 107.1 | 296 | 263.7 | 134.4 |
| 57 | 50.8 | 25.9 | 117 | 104.2 | 53.1 | 177 | 157.7 | 80.4 | 237 | 211.2 | 107.6 | 297 | 264.6 | 134.8 |
| 58 | 51.7 | 26.3 | 118 | 105.1 | 53.6 | 178 | 158.6 | 80.8 | 238 | 212.1 | 108.0 | 298 | 265.5 | 135.3 |
| 59 | 52.6 | 26.8 | 119 | 106.0 | 54.0 | 179 | 159.5 | 81.3 | 239 | 213.0 | 108.5 | 299 | 266.4 | 135.7 |
| 60 | 53.5 | 27.2 | 120 | 106.9 | 54.5 | 180 | 160.4 | 81.7 | 240 | 213.8 | 109.0 | 300 | 267.3 | 136.2 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 63 Degrees.

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# TABLE II

## Difference of Latitude and Departure for 28 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.5 | 61 | 53.9 | 28.6 | 121 | 106.8 | 56.8 | 181 | 159.8 | 85.0 | 241 | 212.8 | 113.1 |
| 2 | 01.8 | 00.9 | 62 | 54.7 | 29.1 | 122 | 107.7 | 57.3 | 182 | 160.7 | 85.4 | 242 | 213.7 | 113.6 |
| 3 | 02.6 | 01.4 | 63 | 55.6 | 29.6 | 123 | 108.6 | 57.7 | 183 | 161.6 | 85.9 | 243 | 214.6 | 114.1 |
| 4 | 03.5 | 01.9 | 64 | 56.5 | 30.0 | 124 | 109.5 | 58.2 | 184 | 162.5 | 86.4 | 244 | 215.4 | 114.6 |
| 5 | 04.4 | 02.3 | 65 | 57.4 | 30.5 | 125 | 110.4 | 58.7 | 185 | 163.3 | 86.9 | 245 | 216.3 | 115.0 |
| 6 | 05.3 | 02.8 | 66 | 58.3 | 31.0 | 126 | 111.3 | 59.2 | 186 | 164.2 | 87.3 | 246 | 217.2 | 115.5 |
| 7 | 06.2 | 03.3 | 67 | 59.2 | 31.5 | 127 | 112.1 | 59.6 | 187 | 165.1 | 87.8 | 247 | 218.1 | 116.0 |
| 8 | 07.1 | 03.8 | 68 | 60.0 | 31.9 | 128 | 113.0 | 60.1 | 188 | 166.0 | 88.3 | 248 | 219.0 | 116.4 |
| 9 | 07.9 | 04.2 | 69 | 60.9 | 32.4 | 129 | 113.9 | 60.6 | 189 | 166.9 | 88.7 | 249 | 219.9 | 116.9 |
| 10 | 08.8 | 04.7 | 70 | 61.8 | 32.9 | 130 | 114.8 | 61.0 | 190 | 167.8 | 89.2 | 250 | 220.7 | 117.4 |
| 11 | 09.7 | 05.2 | 71 | 62.7 | 33.3 | 131 | 115.7 | 61.5 | 191 | 168.6 | 89.7 | 251 | 221.6 | 117.9 |
| 12 | 10.6 | 05.6 | 72 | 63.6 | 33.8 | 132 | 116.5 | 62.0 | 192 | 169.5 | 90.1 | 252 | 222.5 | 118.3 |
| 13 | 11.5 | 06.1 | 73 | 64.5 | 34.3 | 133 | 117.4 | 62.4 | 193 | 170.4 | 90.6 | 253 | 223.4 | 118.8 |
| 14 | 12.4 | 06.6 | 74 | 65.3 | 34.7 | 134 | 118.3 | 62.9 | 194 | 171.3 | 91.1 | 254 | 224.3 | 119.2 |
| 15 | 13.2 | 07.0 | 75 | 66.2 | 35.2 | 135 | 119.2 | 63.4 | 195 | 172.2 | 91.5 | 255 | 225.2 | 119.7 |
| 16 | 14.1 | 07.5 | 76 | 67.1 | 35.7 | 136 | 120.1 | 63.8 | 196 | 173.1 | 92.0 | 256 | 226.0 | 120.2 |
| 17 | 15.0 | 08.0 | 77 | 68.0 | 36.1 | 137 | 121.0 | 64.3 | 197 | 173.9 | 92.5 | 257 | 226.9 | 120.7 |
| 18 | 15.9 | 08.5 | 78 | 68.9 | 36.6 | 138 | 121.8 | 64.8 | 198 | 174.8 | 93.0 | 258 | 227.8 | 121.1 |
| 19 | 16.8 | 08.9 | 79 | 69.8 | 37.1 | 139 | 122.7 | 65.3 | 199 | 175.7 | 93.4 | 259 | 228.7 | 121.6 |
| 20 | 17.7 | 09.4 | 80 | 70.6 | 37.6 | 140 | 123.6 | 65.7 | 200 | 176.6 | 93.9 | 260 | 229.6 | 122.1 |
| 21 | 18.5 | 09.9 | 81 | 71.5 | 38.0 | 141 | 124.5 | 66.2 | 201 | 177.5 | 94.4 | 261 | 230.4 | 122.5 |
| 22 | 19.4 | 10.3 | 82 | 72.4 | 38.5 | 142 | 125.4 | 66.7 | 202 | 178.4 | 94.8 | 262 | 231.3 | 123.0 |
| 23 | 20.3 | 10.8 | 83 | 73.3 | 39.0 | 143 | 126.3 | 67.1 | 203 | 179.2 | 95.3 | 263 | 232.2 | 123.5 |
| 24 | 21.2 | 11.3 | 84 | 74.2 | 39.4 | 144 | 127.1 | 67.6 | 204 | 180.1 | 95.8 | 264 | 233.1 | 123.9 |
| 25 | 22.1 | 11.7 | 85 | 75.1 | 39.9 | 145 | 128.0 | 68.1 | 205 | 181.0 | 96.2 | 265 | 234.0 | 124.4 |
| 26 | 23.0 | 12.2 | 86 | 75.9 | 40.4 | 146 | 128.9 | 68.5 | 206 | 181.9 | 96.7 | 266 | 234.9 | 124.9 |
| 27 | 23.8 | 12.7 | 87 | 76.8 | 40.8 | 147 | 129.8 | 69.0 | 207 | 182.8 | 97.2 | 267 | 235.7 | 125.3 |
| 28 | 24.7 | 13.1 | 88 | 77.7 | 41.3 | 148 | 130.7 | 69.5 | 208 | 183.7 | 97.7 | 268 | 236.6 | 125.8 |
| 29 | 25.6 | 13.6 | 89 | 78.6 | 41.8 | 149 | 131.6 | 70.0 | 209 | 184.5 | 98.1 | 269 | 237.5 | 126.3 |
| 30 | 26.5 | 14.1 | 90 | 79.5 | 42.3 | 150 | 132.4 | 70.4 | 210 | 185.4 | 98.6 | 270 | 238.4 | 126.8 |
| 31 | 27.4 | 14.6 | 91 | 80.3 | 42.7 | 151 | 133.3 | 70.9 | 211 | 186.3 | 99.1 | 271 | 239.3 | 127.2 |
| 32 | 28.3 | 15.0 | 92 | 81.2 | 43.2 | 152 | 134.2 | 71.4 | 212 | 187.2 | 99.5 | 272 | 240.2 | 127.7 |
| 33 | 29.1 | 15.5 | 93 | 82.1 | 43.7 | 153 | 135.1 | 71.8 | 213 | 188.1 | 100.0 | 273 | 241.0 | 128.2 |
| 34 | 30.0 | 16.0 | 94 | 83.0 | 44.1 | 154 | 136.0 | 72.3 | 214 | 189.0 | 100.5 | 274 | 241.9 | 128.6 |
| 35 | 30.9 | 16.4 | 95 | 83.9 | 44.6 | 155 | 136.9 | 72.8 | 215 | 189.8 | 100.9 | 275 | 242.8 | 129.1 |
| 36 | 31.8 | 16.9 | 96 | 84.8 | 45.1 | 156 | 137.7 | 73.2 | 216 | 190.7 | 101.4 | 276 | 243.7 | 129.6 |
| 37 | 32 7 | 17.4 | 97 | 85.6 | 45.5 | 157 | 138.6 | 73.7 | 217 | 191.6 | 101.9 | 277 | 244.6 | 130.0 |
| 38 | 33.6 | 17.8 | 98 | 86.5 | 46.0 | 158 | 139.5 | 74.2 | 218 | 192.5 | 102.3 | 278 | 245.5 | 130.5 |
| 39 | 34.4 | 18.3 | 99 | 87.4 | 46.5 | 159 | 140.4 | 74.6 | 219 | 193.4 | 102.8 | 279 | 246.3 | 131.0 |
| 40 | 35.3 | 18.8 | 100 | 88.3 | 46.9 | 160 | 141.3 | 75.1 | 220 | 194.2 | 103.3 | 280 | 247.2 | 131.5 |
| 41 | 36.2 | 19.2 | 101 | 89.2 | 47.4 | 161 | 142.2 | 75.6 | 221 | 195.1 | 103.8 | 281 | 248.1 | 131.9 |
| 42 | 37.1 | 19.7 | 102 | 90.1 | 47.9 | 162 | 143.0 | 76.1 | 222 | 196.0 | 104.2 | 282 | 249.0 | 132.4 |
| 43 | 38.0 | 20.2 | 103 | 90.9 | 48.4 | 163 | 143.9 | 76.5 | 223 | 196.9 | 104.7 | 283 | 249.9 | 132.9 |
| 44 | 38 8 | 20.7 | 104 | 91.8 | 48.8 | 164 | 144.8 | 77.0 | 224 | 197.8 | 105.2 | 284 | 250.8 | 133.3 |
| 45 | 39.7 | 21.1 | 105 | 92.7 | 49.3 | 165 | 145.7 | 77.5 | 225 | 198.7 | 105.6 | 285 | 251.6 | 133.8 |
| 46 | 40.6 | 21.6 | 106 | 93.6 | 49.8 | 166 | 146.6 | 77.9 | 226 | 199.5 | 106.1 | 286 | 252.5 | 134.3 |
| 47 | 41.5 | 22.1 | 107 | 94.5 | 50.2 | 167 | 147.5 | 78.4 | 227 | 200.4 | 106.6 | 287 | 253.4 | 134.7 |
| 48 | 42.4 | 22.5 | 108 | 95.4 | 50.7 | 168 | 148.3 | 78.9 | 228 | 201.3 | 107.0 | 288 | 254.3 | 135.2 |
| 49 | 43.3 | 23.0 | 109 | 96.2 | 51.2 | 169 | 149.2 | 79.3 | 229 | 202.2 | 107.5 | 289 | 255.2 | 135.7 |
| 50 | 44.1 | 23.5 | 110 | 97.1 | 51.6 | 170 | 150.1 | 79.8 | 230 | 203.1 | 108.0 | 290 | 256.1 | 136.1 |
| 51 | 45.0 | 23.9 | 111 | 98.0 | 52.1 | 171 | 151.0 | 80.3 | 231 | 204.0 | 108.4 | 291 | 256.9 | 136.6 |
| 52 | 45.9 | 24.4 | 112 | 98.9 | 52.6 | 172 | 151.9 | 80.7 | 232 | 204.8 | 108.9 | 292 | 257.8 | 137.1 |
| 53 | 46.8 | 24.9 | 113 | 99.8 | 53.1 | 173 | 152.7 | 81.2 | 233 | 205.7 | 109.4 | 293 | 258.7 | 137.6 |
| 54 | 47.7 | 25.4 | 114 | 100.7 | 53.5 | 174 | 153.6 | 81.7 | 234 | 206.6 | 109.9 | 294 | 259.6 | 138.0 |
| 55 | 48.6 | 25.8 | 115 | 101.5 | 54.0 | 175 | 154.5 | 82.2 | 235 | 207.5 | 110.3 | 295 | 260.5 | 138.5 |
| 56 | 49.4 | 26.3 | 116 | 102.4 | 54.5 | 176 | 155.4 | 82.6 | 236 | 208.4 | 110.8 | 296 | 261.3 | 139.0 |
| 57 | 50.3 | 26.8 | 117 | 103.3 | 54.9 | 177 | 156.3 | 83.1 | 237 | 209.3 | 111.3 | 297 | 262.2 | 139.4 |
| 58 | 51.2 | 27.2 | 118 | 104.2 | 55.4 | 178 | 157.2 | 83.6 | 238 | 210.1 | 111.7 | 298 | 263.1 | 139.9 |
| 59 | 52.1 | 27.7 | 119 | 105.1 | 55.9 | 179 | 158.0 | 84.0 | 239 | 211.0 | 112.2 | 299 | 264.0 | 140.4 |
| 60 | 53.0 | 28.2 | 120 | 106.0 | 56.3 | 180 | 158.9 | 84.5 | 240 | 211.9 | 112.7 | 300 | 264.9 | 140.8 |

| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

For 62 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 29 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.5 | 61 | 53.4 | 29.6 | 121 | 105.8 | 58.7 | 181 | 158.3 | 87.8 | 241 | 210.8 | 116.8 |
| 2 | 01.7 | 01.0 | 62 | 54.2 | 30.1 | 122 | 106.7 | 59.1 | 182 | 159.2 | 88.2 | 242 | 211.7 | 117.3 |
| 3 | 02.6 | 01.5 | 63 | 55.1 | 30.5 | 123 | 107.6 | 59.6 | 183 | 160.1 | 88.7 | 243 | 212.5 | 117.8 |
| 4 | 03.5 | 01.9 | 64 | 56.0 | 31.0 | 124 | 108.5 | 60.1 | 184 | 160.9 | 89.2 | 244 | 213.4 | 118.3 |
| 5 | 04.4 | 02.4 | 65 | 56.9 | 31.5 | 125 | 109.3 | 60.6 | 185 | 161.8 | 89.7 | 245 | 214.3 | 118.8 |
| 6 | 05.2 | 02.9 | 66 | 57.7 | 32.0 | 126 | 110.2 | 61.1 | 186 | 162.7 | 90.2 | 246 | 215.2 | 119.3 |
| 7 | 06.1 | 03.4 | 67 | 58.6 | 32.5 | 127 | 111.1 | 61.6 | 187 | 163.6 | 90.7 | 247 | 216.0 | 119.7 |
| 8 | 07.0 | 03.9 | 68 | 59.5 | 33.0 | 128 | 112.0 | 62.1 | 188 | 164.4 | 91.1 | 248 | 216.9 | 120.2 |
| 9 | 07.9 | 04.4 | 69 | 60.3 | 33.5 | 129 | 112.8 | 62.5 | 189 | 165.3 | 91.6 | 249 | 217.8 | 120.7 |
| 10 | 08.7 | 04.8 | 70 | 61.2 | 33.9 | 130 | 113.7 | 63.0 | 190 | 166.2 | 92.1 | 250 | 218.7 | 121.2 |
| 11 | 09.6 | 05.3 | 71 | 62.1 | 34.4 | 131 | 114.6 | 63.5 | 191 | 167.1 | 92.6 | 251 | 219.5 | 121.7 |
| 12 | 10.5 | 05.8 | 72 | 63.0 | 34.9 | 132 | 115.4 | 64.0 | 192 | 167.9 | 93.1 | 252 | 220.4 | 122.2 |
| 13 | 11.4 | 06.3 | 73 | 63.8 | 35.4 | 133 | 116.3 | 64.5 | 193 | 168.8 | 93.6 | 253 | 221.3 | 122.7 |
| 14 | 12.2 | 06.8 | 74 | 64.7 | 35.9 | 134 | 117.2 | 65.0 | 194 | 169.7 | 94.1 | 254 | 222.2 | 123.1 |
| 15 | 13.1 | 07.3 | 75 | 65.6 | 36.4 | 135 | 118.1 | 65.4 | 195 | 170.6 | 94.5 | 255 | 223.0 | 123.6 |
| 16 | 14.0 | 07.8 | 76 | 66.5 | 36.8 | 136 | 118.9 | 65.9 | 196 | 171.4 | 95.0 | 256 | 223.9 | 124.1 |
| 17 | 14.9 | 08.2 | 77 | 67.3 | 37.3 | 137 | 119.8 | 66.4 | 197 | 172.3 | 95.5 | 257 | 224.8 | 124.6 |
| 18 | 15.7 | 08.7 | 78 | 68.2 | 37.8 | 138 | 120.7 | 66.9 | 198 | 173.2 | 96.0 | 258 | 225.7 | 125.1 |
| 19 | 16.6 | 09.2 | 79 | 69.1 | 38.3 | 139 | 121.6 | 67.4 | 199 | 174.0 | 96.5 | 259 | 226.5 | 125.6 |
| 20 | 17.5 | 09.7 | 80 | 70.0 | 38.8 | 140 | 122.4 | 67.9 | 200 | 174.9 | 97.0 | 260 | 227.4 | 126.1 |
| 21 | 18.4 | 10.2 | 81 | 70.8 | 39.3 | 141 | 123.3 | 68.4 | 201 | 175.8 | 97.4 | 261 | 228.3 | 126.5 |
| 22 | 19.2 | 10.7 | 82 | 71.7 | 39.8 | 142 | 124.2 | 68.8 | 202 | 176.7 | 97.9 | 262 | 229.2 | 127.0 |
| 23 | 20.1 | 11.2 | 83 | 72.6 | 40.2 | 143 | 125.1 | 69.3 | 203 | 177.5 | 98.4 | 263 | 230.0 | 127.5 |
| 24 | 21.0 | 11.6 | 84 | 73.5 | 40.7 | 144 | 125.9 | 69.8 | 204 | 178.4 | 98.9 | 264 | 230.9 | 128.0 |
| 25 | 21.9 | 12.1 | 85 | 74.3 | 41.2 | 145 | 126.8 | 70.3 | 205 | 179.3 | 99.4 | 265 | 231.8 | 128.5 |
| 26 | 22.7 | 12.6 | 86 | 75.2 | 41.7 | 146 | 127.7 | 70.8 | 206 | 180.2 | 99.9 | 266 | 232.6 | 129.0 |
| 27 | 23.6 | 13.1 | 87 | 76.1 | 42.2 | 147 | 128.6 | 71.3 | 207 | 181.0 | 100.4 | 267 | 233.5 | 129.4 |
| 28 | 24.5 | 13.6 | 88 | 77.0 | 42.7 | 148 | 129.4 | 71.8 | 208 | 181.9 | 100.8 | 268 | 234.4 | 129.9 |
| 29 | 25.4 | 14.1 | 89 | 77.8 | 43.1 | 149 | 130.3 | 72.2 | 209 | 182.8 | 101.3 | 269 | 235.3 | 130.4 |
| 30 | 26.2 | 14.5 | 90 | 78.7 | 43.6 | 150 | 131.2 | 72.7 | 210 | 183.7 | 101.8 | 270 | 236.1 | 130.9 |
| 31 | 27.1 | 15.0 | 91 | 79.6 | 44.1 | 151 | 132.1 | 73.2 | 211 | 184.5 | 102.3 | 271 | 237.0 | 131.4 |
| 32 | 28.0 | 15.5 | 92 | 80.5 | 44.6 | 152 | 132.9 | 73.7 | 212 | 185.4 | 102.8 | 272 | 237.9 | 131.9 |
| 33 | 28.9 | 16.0 | 93 | 81.3 | 45.1 | 153 | 133.8 | 74.2 | 213 | 186.3 | 103.3 | 273 | 238.8 | 132.4 |
| 34 | 29.7 | 16.5 | 94 | 82.2 | 45.6 | 154 | 134.7 | 74.7 | 214 | 187.2 | 103.7 | 274 | 239.6 | 132.8 |
| 35 | 30.6 | 17.0 | 95 | 83.1 | 46.1 | 155 | 135.6 | 75.1 | 215 | 188.0 | 104.2 | 275 | 240.5 | 133.3 |
| 36 | 31.5 | 17.5 | 96 | 84.0 | 46.5 | 156 | 136.4 | 75.6 | 216 | 188.9 | 104.7 | 276 | 241.4 | 133.8 |
| 37 | 32.4 | 17.9 | 97 | 84.8 | 47.0 | 157 | 137.3 | 76.1 | 217 | 189.8 | 105.2 | 277 | 242.3 | 134.3 |
| 38 | 33.2 | 18.4 | 98 | 85.7 | 47.5 | 158 | 138.2 | 76.6 | 218 | 190.7 | 105.7 | 278 | 243.1 | 134.8 |
| 39 | 34.1 | 18.9 | 99 | 86.6 | 48.0 | 159 | 139·1 | 77.1 | 219 | 191.5 | 106.2 | 279 | 244.0 | 135.3 |
| 40 | 35.0 | 19.4 | 100 | 87.5 | 48.5 | 160 | 139.9 | 77.6 | 220 | 192.4 | 106.7 | 280 | 244.9 | 135.7 |
| 41 | 35.9 | 19.9 | 101 | 88.3 | 49.0 | 161 | 140.8 | 78.1 | 221 | 193.3 | 107.1 | 281 | 245.8 | 136.2 |
| 42 | 36.7 | 20.4 | 102 | 89.2 | 49.5 | 162 | 141.7 | 78.5 | 222 | 194.2 | 107.6 | 282 | 246.6 | 136.7 |
| 43 | 37.6 | 20.8 | 103 | 90.1 | 49.9 | 163 | 142.6 | 79.0 | 223 | 195.0 | 108.1 | 283 | 247.5 | 137.2 |
| 44 | 38.5 | 21.3 | 104 | 91.0 | 50.4 | 164 | 143.4 | 79.5 | 224 | 195.9 | 108.6 | 284 | 248.4 | 137.7 |
| 45 | 39.4 | 21 8 | 105 | 91.8 | 50.9 | 165 | 144.3 | 80.0 | 225 | 196.8 | 109.1 | 285 | 249.3 | 138.2 |
| 46 | 40.2 | 22.3 | 106 | 92.7 | 51.4 | 166 | 145.2 | 80.5 | 226 | 197.7 | 109.6 | 286 | 250.1 | 138.7 |
| 47 | 41.1 | 22.8 | 107 | 93.6 | 51.9 | 167 | 146.1 | 81.0 | 227 | 198.5 | 110.1 | 287 | 251.0 | 139.1 |
| 48 | 42.0 | 23.3 | 108 | 94.5 | 52.4 | 168 | 146.9 | 81.4 | 228 | 199.4 | 110.5 | 288 | 251.9 | 139.6 |
| 49 | 42.9 | 23.8 | 109 | 95.3 | 52.8 | 169 | 147.8 | 81.9 | 229 | 200.3 | 111.0 | 289 | 252.8 | 140.1 |
| 50 | 43.7 | 24.2 | 110 | 96.2 | 53.3 | 170 | 148.7 | 82.4 | 230 | 201.2 | 111.5 | 290 | 253.6 | 140.6 |
| 51 | 44.6 | 24.7 | 111 | 97.1 | 53.8 | 171 | 149.6 | 82.9 | 231 | 202.0 | 112.0 | 291 | 254.5 | 141.1 |
| 52 | 45.5 | 25.2 | 112 | 98.0 | 54.3 | 172 | 150.4 | 83.4 | 232 | 202.9 | 112.5 | 292 | 255.4 | 141.6 |
| 53 | 46.4 | 25.7 | 113 | 98.8 | 54.8 | 173 | 151.3 | 83.9 | 233 | 203.8 | 113.0 | 293 | 256.3 | 142.0 |
| 54 | 47.2 | 26.2 | 114 | 99.7 | 55.3 | 174 | 152.2 | 84.4 | 234 | 204.7 | 113.4 | 294 | 257.1 | 142.5 |
| 55 | 48.1 | 26.7 | 115 | 100.6 | 55.8 | 175 | 153.1 | 84.8 | 235 | 205.5 | 113.9 | 295 | 258.0 | 143.0 |
| 56 | 49.0 | 27.1 | 116 | 101.5 | 56.2 | 176 | 153.9 | 85.3 | 236 | 206.4 | 114.4 | 296 | 258.9 | 143.5 |
| 57 | 49.9 | 27.6 | 117 | 102.3 | 56.7 | 177 | 154.8 | 85.8 | 237 | 207.3 | 114.9 | 297 | 259.8 | 144.0 |
| 58 | 50.7 | 28.1 | 118 | 103.2 | 57.2 | 178 | 155.7 | 86.3 | 238 | 208.2 | 115.4 | 298 | 260.6 | 144.5 |
| 59 | 51.6 | 28.6 | 119 | 104.1 | 57.7 | 179 | 156.6 | 86.8 | 239 | 209.0 | 115.9 | 299 | 261.5 | 145.0 |
| 60 | 52.5 | 29.1 | 120 | 105.0 | 58.2 | 180 | 157.4 | 87.3 | 240 | 209.9 | 116.4 | 300 | 262.4 | 145.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist | Dep. | Lat. | Dist. | Dep. | Lat. |

For 61 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 30 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.5 | 61 | 52.8 | 30.5 | 121 | 104.8 | 60.5 | 181 | 156.8 | 90.5 | 241 | 208.7 | 120.5 |
| 2 | 01.7 | 01.0 | 62 | 53.7 | 31.0 | 122 | 105.7 | 61.0 | 182 | 157.6 | 91.0 | 242 | 209.6 | 121.0 |
| 3 | 02.6 | 01.5 | 63 | 54.6 | 31.5 | 123 | 106.5 | 61.5 | 183 | 158.5 | 91.5 | 243 | 210.4 | 121.5 |
| 4 | 03.5 | 02.0 | 64 | 55.4 | 32.0 | 124 | 107.4 | 62.0 | 184 | 159.3 | 92.0 | 244 | 211.3 | 122.0 |
| 5 | 04.3 | 02.5 | 65 | 56.3 | 32.5 | 125 | 108.3 | 62.5 | 185 | 160.2 | 92.5 | 245 | 212.2 | 122.5 |
| 6 | 05.2 | 03.0 | 66 | 57.2 | 33.0 | 126 | 109.1 | 63.0 | 186 | 161.1 | 93.0 | 246 | 213.0 | 123.0 |
| 7 | 06.1 | 03.5 | 67 | 58.0 | 33.5 | 127 | 110.0 | 63.5 | 187 | 161.9 | 93.5 | 247 | 213.9 | 123.5 |
| 8 | 06.9 | 04.0 | 68 | 58.9 | 34.0 | 128 | 110.9 | 64.0 | 188 | 162.8 | 94.0 | 248 | 214.8 | 124.0 |
| 9 | 07.8 | 04.5 | 69 | 59.8 | 34.5 | 129 | 111.7 | 64.5 | 189 | 163.7 | 94.5 | 249 | 215.6 | 124.5 |
| 10 | 08.7 | 05.0 | 70 | 60.6 | 35.0 | 130 | 112.6 | 65.0 | 190 | 164.5 | 95.0 | 250 | 216.5 | 125.0 |
| 11 | 09.5 | 05.5 | 71 | 61.5 | 35.5 | 131 | 113.4 | 65.5 | 191 | 165.4 | 95.5 | 251 | 217.4 | 125.5 |
| 12 | 10.4 | 06.0 | 72 | 62.4 | 36.0 | 132 | 114.3 | 66.0 | 192 | 166.3 | 96.0 | 252 | 218.2 | 126.0 |
| 13 | 11.3 | 06.5 | 73 | 63.2 | 36.5 | 133 | 115.2 | 66.5 | 193 | 167.1 | 96.5 | 253 | 219.1 | 126.5 |
| 14 | 12.1 | 07.0 | 74 | 64.1 | 37.0 | 134 | 116.0 | 67.0 | 194 | 168.0 | 97.0 | 254 | 220.0 | 127.0 |
| 15 | 13.0 | 07.5 | 75 | 65.0 | 37.5 | 135 | 116.9 | 67.5 | 195 | 168.9 | 97.5 | 255 | 220.8 | 127.5 |
| 16 | 13.9 | 08.0 | 76 | 65.8 | 38.0 | 136 | 117.8 | 68.0 | 196 | 169.7 | 98.0 | 256 | 221.7 | 128.0 |
| 17 | 14.7 | 08.5 | 77 | 66.7 | 38.5 | 137 | 118.6 | 68.5 | 197 | 170.6 | 98.5 | 257 | 222.6 | 128.5 |
| 18 | 15.6 | 09.0 | 78 | 67.5 | 39.0 | 138 | 119.5 | 69.0 | 198 | 171.5 | 99.0 | 258 | 223.4 | 129.0 |
| 19 | 16.5 | 09.5 | 79 | 68.4 | 39.5 | 139 | 120.4 | 69.5 | 199 | 172.3 | 99.5 | 259 | 224.3 | 129.5 |
| 20 | 17.3 | 10.0 | 80 | 69.3 | 40.0 | 140 | 121.2 | 70.0 | 200 | 173.2 | 100.0 | 260 | 225.2 | 130.0 |
| 21 | 18.2 | 10.5 | 81 | 70.1 | 40.5 | 141 | 122.1 | 70.5 | 201 | 174.1 | 100.5 | 261 | 226.0 | 130.5 |
| 22 | 19.1 | 11.0 | 82 | 71.0 | 41.0 | 142 | 123.0 | 71.0 | 202 | 174.9 | 101.0 | 262 | 226.9 | 131.0 |
| 23 | 19.9 | 11.5 | 83 | 71.9 | 41.5 | 143 | 123.8 | 71.5 | 203 | 175.8 | 101.5 | 263 | 227.8 | 131.5 |
| 24 | 20.8 | 12.0 | 84 | 72.7 | 42.0 | 144 | 124.7 | 72.0 | 204 | 176.7 | 102.0 | 264 | 228.6 | 132.0 |
| 25 | 21.7 | 12.5 | 85 | 73.6 | 42.5 | 145 | 125.6 | 72.5 | 205 | 177.5 | 102.5 | 265 | 229.5 | 132.5 |
| 26 | 22.5 | 13.0 | 86 | 74.5 | 43.0 | 146 | 126.4 | 73.0 | 206 | 178.4 | 103.0 | 266 | 230.4 | 133.0 |
| 27 | 23.4 | 13.5 | 87 | 75.3 | 43.5 | 147 | 127.3 | 73.5 | 207 | 179.3 | 103.5 | 267 | 231.2 | 133.5 |
| 28 | 24.2 | 14.0 | 88 | 76.2 | 44.0 | 148 | 128.2 | 74.0 | 208 | 180.1 | 104.0 | 268 | 232.1 | 134.0 |
| 29 | 25.1 | 14.5 | 89 | 77.1 | 44.5 | 149 | 129.0 | 74.5 | 209 | 181.0 | 104.5 | 269 | 233.0 | 134.5 |
| 30 | 26.0 | 15.0 | 90 | 77.9 | 45.0 | 150 | 129.9 | 75.0 | 210 | 181.9 | 105.0 | 270 | 233.8 | 135.0 |
| 31 | 26.8 | 15.5 | 91 | 78.8 | 45.5 | 151 | 130.8 | 75.5 | 211 | 182.7 | 105.5 | 271 | 234.7 | 135.5 |
| 32 | 27.7 | 16.0 | 92 | 79.7 | 46.0 | 152 | 131.6 | 76.0 | 212 | 183.6 | 106.0 | 272 | 235.6 | 136.0 |
| 33 | 28.6 | 16.5 | 93 | 80.5 | 46.5 | 153 | 132.5 | 76.5 | 213 | 184.5 | 106.5 | 273 | 236.4 | 136.5 |
| 34 | 29.4 | 17.0 | 94 | 81.4 | 47.0 | 154 | 133.4 | 77.0 | 214 | 185.3 | 107.0 | 274 | 237.3 | 137.0 |
| 35 | 30.3 | 17.5 | 95 | 82.3 | 47.5 | 155 | 134.2 | 77.5 | 215 | 186.2 | 107.5 | 275 | 238.2 | 137.5 |
| 36 | 31.2 | 18.0 | 96 | 83.1 | 48.0 | 156 | 135.1 | 78.0 | 216 | 187.1 | 108.0 | 276 | 239.0 | 138.0 |
| 37 | 32.0 | 18.5 | 97 | 84.0 | 48.5 | 157 | 130.0 | 78.5 | 217 | 187.9 | 108.5 | 277 | 239.9 | 138.5 |
| 38 | 32.9 | 19.0 | 98 | 84.9 | 49.0 | 158 | 136.8 | 79.0 | 218 | 188.8 | 109.0 | 278 | 240.8 | 139.0 |
| 39 | 33.8 | 19.5 | 99 | 85.7 | 49.5 | 159 | 137.7 | 79.5 | 219 | 189.7 | 109.5 | 279 | 241.6 | 139.5 |
| 40 | 34.6 | 20.0 | 100 | 86.6 | 50.0 | 160 | 138.6 | 80.0 | 220 | 190.5 | 110.0 | 280 | 242.5 | 140.0 |
| 41 | 35.5 | 20.5 | 101 | 87.5 | 50.5 | 161 | 139.4 | 80.5 | 221 | 191.4 | 110.5 | 281 | 243.4 | 140.5 |
| 42 | 36.4 | 21.0 | 102 | 88.3 | 51.0 | 162 | 140.3 | 81.0 | 222 | 192.3 | 111.0 | 282 | 244.2 | 141.0 |
| 43 | 37.2 | 21.5 | 103 | 89.2 | 51.5 | 163 | 141.2 | 81.5 | 223 | 193.1 | 111.5 | 283 | 245.1 | 141.5 |
| 44 | 38.1 | 22.0 | 104 | 90.1 | 52.0 | 164 | 142.0 | 82.0 | 224 | 194.0 | 112.0 | 284 | 246.0 | 142.0 |
| 45 | 39.0 | 22.5 | 105 | 90.9 | 52.5 | 165 | 142.9 | 82.5 | 225 | 194.9 | 112.5 | 285 | 246.8 | 142.5 |
| 46 | 39.8 | 23.0 | 106 | 91.8 | 53.0 | 166 | 143.8 | 83.0 | 226 | 195.7 | 113.0 | 286 | 247.7 | 143.0 |
| 47 | 40.7 | 23.5 | 107 | 92.7 | 53.5 | 167 | 144.6 | 83.5 | 227 | 196.6 | 113.5 | 287 | 248.5 | 143.5 |
| 48 | 41.6 | 24.0 | 108 | 93.5 | 54.0 | 168 | 145.5 | 84.0 | 228 | 197.5 | 114.0 | 288 | 249.4 | 144.0 |
| 49 | 42.4 | 24.5 | 109 | 94.4 | 54.5 | 169 | 146.4 | 84.5 | 229 | 198.3 | 114.5 | 289 | 250.3 | 144.5 |
| 50 | 43.3 | 25.0 | 110 | 95.3 | 55.0 | 170 | 147.2 | 85.0 | 230 | 199.2 | 115.0 | 290 | 251.1 | 145.0 |
| 51 | 44.2 | 25.5 | 111 | 96.1 | 55.5 | 171 | 148.1 | 85.5 | 231 | 200.1 | 115.5 | 291 | 252.0 | 145.5 |
| 52 | 45.0 | 26.0 | 112 | 97.0 | 56.0 | 172 | 149.0 | 86.0 | 232 | 200.9 | 116.0 | 292 | 252.9 | 146.0 |
| 53 | 45.9 | 26.5 | 113 | 97.9 | 56.5 | 173 | 149.8 | 86.5 | 233 | 201.8 | 116.5 | 293 | 253.7 | 146.5 |
| 54 | 46.8 | 27.0 | 114 | 98.7 | 57.0 | 174 | 150.7 | 87.0 | 234 | 202.6 | 117.0 | 294 | 254.6 | 147.0 |
| 55 | 47.6 | 27.5 | 115 | 99.6 | 57.5 | 175 | 151.6 | 87.5 | 235 | 203.5 | 117.5 | 295 | 255.5 | 147.5 |
| 56 | 48.5 | 28.0 | 116 | 100.5 | 58.0 | 176 | 152.4 | 88.0 | 236 | 204.4 | 118.0 | 296 | 256.3 | 148.0 |
| 57 | 49.4 | 28.5 | 117 | 101.3 | 58.5 | 177 | 153.3 | 88.5 | 237 | 205.2 | 118.5 | 297 | 257.2 | 148.5 |
| 58 | 50.2 | 29.0 | 118 | 102.2 | 59.0 | 178 | 154.2 | 89.0 | 238 | 206.1 | 119.0 | 298 | 258.1 | 149.0 |
| 59 | 51.1 | 29.5 | 119 | 103.1 | 59.5 | 179 | 155.0 | 89.5 | 239 | 207.0 | 119.5 | 299 | 258.9 | 149.5 |
| 60 | 52.0 | 30.0 | 120 | 103.9 | 60.0 | 180 | 155.9 | 90.0 | 240 | 207.8 | 120.0 | 300 | 259.8 | 150.0 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 60 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 31 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.9 | 00.5 | 61 | 52.3 | 31.4 | 121 | 103.7 | 62.3 | 181 | 155.1 | 93.2 | 241 | 206.6 | 124.1 |
| 2 | 01.7 | 01.0 | 62 | 53.1 | 31.9 | 122 | 104.6 | 62.8 | 182 | 156.0 | 93.7 | 242 | 207.4 | 124.6 |
| 3 | 02.6 | 01.5 | 63 | 54.0 | 32.4 | 123 | 105.4 | 63.3 | 183 | 156.9 | 94.3 | 243 | 208.3 | 125.2 |
| 4 | 03.4 | 02.1 | 64 | 54.9 | 33.0 | 124 | 106.3 | 63.9 | 184 | 157.7 | 94.8 | 244 | 209.1 | 125.7 |
| 5 | 04.3 | 02.6 | 65 | 55.7 | 33.5 | 125 | 107.1 | 64.4 | 185 | 158.6 | 95.3 | 245 | 210.0 | 126.2 |
| 6 | 05.1 | 03.1 | 66 | 56.6 | 34.0 | 126 | 108.0 | 64.9 | 186 | 159.4 | 95.8 | 246 | 210.9 | 126.7 |
| 7 | 06.0 | 03.6 | 67 | 57.4 | 34.5 | 127 | 108.9 | 65.4 | 187 | 160.3 | 96.3 | 247 | 211.7 | 127.2 |
| 8 | 06.9 | 04.1 | 68 | 58.3 | 35.0 | 128 | 109.7 | 65.9 | 188 | 161.1 | 96.8 | 248 | 212.6 | 127.7 |
| 9 | 07.7 | 04.6 | 69 | 59.1 | 35.5 | 129 | 110.6 | 66.4 | 189 | 162.0 | 97.3 | 249 | 213.4 | 128.2 |
| 10 | 08.6 | 05.2 | 70 | 60.0 | 36.1 | 130 | 111.4 | 67.0 | 190 | 162.9 | 97.9 | 250 | 214.3 | 128.8 |
| 11 | 09.4 | 05.7 | 71 | 60.9 | 36.6 | 131 | 112.3 | 67.5 | 191 | 163.7 | 98.4 | 251 | 215.1 | 129.3 |
| 12 | 10.3 | 06.2 | 72 | 61.7 | 37.1 | 132 | 113.1 | 68.0 | 192 | 164.6 | 98.9 | 252 | 216.0 | 129.8 |
| 13 | 11.1 | 06.7 | 73 | 62.6 | 37.6 | 133 | 114.0 | 68.5 | 193 | 165.4 | 99.4 | 253 | 216.9 | 130.3 |
| 14 | 12.0 | 07.2 | 74 | 63.4 | 38.1 | 134 | 114.9 | 69.0 | 194 | 166.3 | 99.9 | 254 | 217.7 | 130.8 |
| 15 | 12.9 | 07.7 | 75 | 64.3 | 38.6 | 135 | 115.7 | 69.5 | 195 | 167.1 | 100.4 | 255 | 218.6 | 131.3 |
| 16 | 13.7 | 08.2 | 76 | 65.1 | 39.1 | 136 | 116.6 | 70.0 | 196 | 168.0 | 100.9 | 256 | 219.4 | 131.8 |
| 17 | 14.6 | 08.8 | 77 | 66.0 | 39.7 | 137 | 117.4 | 70.6 | 197 | 168.9 | 101.5 | 257 | 220.3 | 132.4 |
| 18 | 15.4 | 09.3 | 78 | 66.9 | 40.2 | 138 | 118.3 | 71.1 | 198 | 169.7 | 102.0 | 258 | 221.1 | 132.9 |
| 19 | 16.3 | 09.8 | 79 | 67.7 | 40.7 | 139 | 119.1 | 71.6 | 199 | 170.6 | 102.5 | 259 | 222.0 | 133.4 |
| 20 | 17.1 | 10.3 | 80 | 68.6 | 41.2 | 140 | 120.0 | 72.1 | 200 | 171.4 | 103.0 | 260 | 222.9 | 133.9 |
| 21 | 18.0 | 10.8 | 81 | 69.4 | 41.7 | 141 | 120.9 | 72.6 | 201 | 172.3 | 103.5 | 261 | 223.7 | 134.4 |
| 22 | 18.9 | 11.3 | 82 | 70.3 | 42.2 | 142 | 121.7 | 73.1 | 202 | 173.1 | 104.0 | 262 | 224.6 | 134.9 |
| 23 | 19.7 | 11.8 | 83 | 71.1 | 42.7 | 143 | 122.6 | 73.7 | 203 | 174.0 | 104.6 | 263 | 225.4 | 135.5 |
| 24 | 20.6 | 12.4 | 84 | 72.0 | 43.3 | 144 | 123.4 | 74.2 | 204 | 174.9 | 105.1 | 264 | 226.3 | 136.0 |
| 25 | 21.4 | 12.9 | 85 | 72.9 | 43.8 | 145 | 124.3 | 74.7 | 205 | 175.7 | 105.6 | 265 | 227.1 | 136.5 |
| 26 | 22.3 | 13.4 | 86 | 73.7 | 44.3 | 146 | 125.1 | 75.2 | 206 | 176.6 | 106.1 | 266 | 228.0 | 137.0 |
| 27 | 23.1 | 13.9 | 87 | 74.6 | 44.8 | 147 | 126.0 | 75.7 | 207 | 177.4 | 106.6 | 267 | 228.9 | 137.5 |
| 28 | 24.0 | 14.4 | 88 | 75.4 | 45.3 | 148 | 126.9 | 76.2 | 208 | 178.3 | 107.1 | 268 | 229.7 | 138.0 |
| 29 | 24.9 | 14.9 | 89 | 76.3 | 45.8 | 149 | 127.7 | 76.7 | 209 | 179.1 | 107.6 | 269 | 230.6 | 138.5 |
| 30 | 25.7 | 15.5 | 90 | 77.1 | 46.4 | 150 | 128.6 | 77.3 | 210 | 180.0 | 108.2 | 270 | 231.4 | 139.1 |
| 31 | 26.6 | 16.0 | 91 | 78.0 | 46.9 | 151 | 129.4 | 77.8 | 211 | 180.9 | 108.7 | 271 | 232.3 | 139.6 |
| 32 | 27.4 | 16.5 | 92 | 78.9 | 47.4 | 152 | 130.3 | 78.3 | 212 | 181.7 | 109.2 | 272 | 233.1 | 140.1 |
| 33 | 28.3 | 17.0 | 93 | 79.7 | 47.9 | 153 | 131.1 | 78.8 | 213 | 182.6 | 109.7 | 273 | 234.0 | 140.6 |
| 34 | 29.1 | 17.5 | 94 | 80.6 | 48.4 | 154 | 132.0 | 79.3 | 214 | 183.4 | 110.2 | 274 | 234.9 | 141.1 |
| 35 | 30.0 | 18.0 | 95 | 81.4 | 48.9 | 155 | 132.9 | 79.8 | 215 | 184.3 | 110.7 | 275 | 235.7 | 141.6 |
| 36 | 30.9 | 18.5 | 96 | 82.3 | 49.4 | 156 | 133.7 | 80.3 | 216 | 185.1 | 111.2 | 276 | 236.6 | 142.2 |
| 37 | 31.7 | 19.1 | 97 | 83.1 | 50.0 | 157 | 134.6 | 80.9 | 217 | 186.0 | 111.8 | 277 | 237.4 | 142.7 |
| 38 | 32.6 | 19.6 | 98 | 84.0 | 50.5 | 158 | 135.4 | 81.4 | 218 | 186.9 | 112.3 | 278 | 238.3 | 143.2 |
| 39 | 33.4 | 20.1 | 99 | 84.9 | 51.0 | 159 | 136.3 | 81.9 | 219 | 187.7 | 112.8 | 279 | 239.1 | 143.7 |
| 40 | 34.3 | 20.6 | 100 | 85.7 | 51.5 | 160 | 137.1 | 82.4 | 220 | 188.6 | 113.3 | 280 | 240.0 | 144.2 |
| 41 | 35.1 | 21.1 | 101 | 86.6 | 52.0 | 161 | 138.0 | 82.9 | 221 | 189.4 | 113.8 | 281 | 240.9 | 144.7 |
| 42 | 36.0 | 21.6 | 102 | 87.4 | 52.5 | 162 | 138.9 | 83.4 | 222 | 190.3 | 114.3 | 282 | 241.7 | 145.2 |
| 43 | 36.9 | 22.1 | 103 | 88.3 | 53.0 | 163 | 139.7 | 84.0 | 223 | 191.1 | 114.9 | 283 | 242.6 | 145.8 |
| 44 | 37.7 | 22.7 | 104 | 89.1 | 53.6 | 164 | 140·6 | 84.5 | 224 | 192.0 | 115.4 | 284 | 243.4 | 146.3 |
| 45 | 38.6 | 23.2 | 105 | 90.0 | 54.1 | 165 | 141.4 | 85.0 | 225 | 192.9 | 115.9 | 285 | 244.3 | 146.8 |
| 46 | 39.4 | 23.7 | 106 | 90.9 | 54.6 | 166 | 142.3 | 85.5 | 226 | 193.7 | 116.4 | 286 | 245.1 | 147.3 |
| 47 | 40.3 | 24.2 | 107 | 91.7 | 55.1 | 167 | 143.1 | 86.0 | 227 | 194.6 | 116.9 | 287 | 246.0 | 147.8 |
| 48 | 41.1 | 24.7 | 108 | 92.6 | 55.6 | 168 | 144.0 | 86.5 | 228 | 195.4 | 117.4 | 288 | 246.9 | 148.3 |
| 49 | 42.0 | 25.2 | 109 | 93.4 | 56.1 | 169 | 144.9 | 87.0 | 229 | 196.3 | 117.9 | 289 | 247.7 | 148.8 |
| 50 | 42.9 | 25.8 | 110 | 94.3 | 56.7 | 170 | 145.7 | 87.6 | 230 | 197.1 | 118.5 | 290 | 248.6 | 149.4 |
| 51 | 43.7 | 26.3 | 111 | 95.1 | 57.2 | 171 | 146.6 | 88.1 | 231 | 198.0 | 119.0 | 291 | 249.4 | 149.9 |
| 52 | 44.6 | 26.8 | 112 | 96.0 | 57.7 | 172 | 147.4 | 88.6 | 232 | 198.9 | 119.5 | 292 | 250.3 | 150.4 |
| 53 | 45.4 | 27.3 | 113 | 96.9 | 58.2 | 173 | 148.3 | 89.1 | 233 | 199.7 | 120.0 | 293 | 251.2 | 150.9 |
| 54 | 46.3 | 27.8 | 114 | 97.7 | 58.7 | 174 | 149.1 | 89.6 | 234 | 200.6 | 120.5 | 294 | 252.0 | 151.4 |
| 55 | 47.1 | 28.3 | 115 | 98.6 | 59.2 | 175 | 150.0 | 90.1 | 235 | 201.4 | 121.0 | 295 | 252.9 | 151.9 |
| 56 | 48.0 | 28.8 | 116 | 99.4 | 59.7 | 176 | 150.9 | 90.6 | 236 | 202.3 | 121.5 | 296 | 253.7 | 152.5 |
| 57 | 48.9 | 29.4 | 117 | 100.3 | 60.3 | 177 | 151.7 | 91.2 | 237 | 203.1 | 122.1 | 297 | 254.6 | 153.0 |
| 58 | 49.7 | 29.9 | 118 | 101.1 | 60.8 | 178 | 152.6 | 91.7 | 238 | 204.0 | 122.6 | 298 | 255.4 | 153.5 |
| 59 | 50.6 | 30.4 | 119 | 102.0 | 61.3 | 179 | 153.4 | 92.2 | 239 | 204.9 | 123.1 | 299 | 256.3 | 154.0 |
| 60 | 51.4 | 30.9 | 120 | 102.9 | 61.8 | 180 | 154.3 | 92.7 | 240 | 205.7 | 123.6 | 300 | 257.1 | 154.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 59 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 32 Degrees.

| st. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.5 | 61 | 51.7 | 32.3 | 121 | 102.6 | 64.1 | 181 | 153.5 | 95.9 | 241 | 204.4 | 127.7 |
| 2 | 01.7 | 01.1 | 62 | 52.6 | 32.9 | 122 | 103.5 | 64.7 | 182 | 154.3 | 96.4 | 242 | 205.2 | 128.2 |
| 3 | 02.5 | 01.6 | 63 | 53.4 | 33.4 | 123 | 104.3 | 65.2 | 183 | 155.2 | 97.0 | 243 | 206.1 | 128.8 |
| 4 | 03.4 | 02.1 | 64 | 54.3 | 33.9 | 124 | 105.2 | 65.7 | 184 | 156.0 | 97.5 | 244 | 206.9 | 129.3 |
| 5 | 04.2 | 02.6 | 65 | 55.1 | 34.4 | 125 | 106.0 | 66.2 | 185 | 156.9 | 98.0 | 245 | 207.8 | 129.8 |
| 6 | 05.1 | 03.2 | 66 | 56.0 | 35.0 | 126 | 106.9 | 66.8 | 186 | 157.7 | 98.6 | 246 | 208.6 | 130.4 |
| 7 | 05.9 | 03.7 | 67 | 56.8 | 35.5 | 127 | 107.7 | 67.3 | 187 | 158.6 | 99.1 | 247 | 209.5 | 130.9 |
| 8 | 06.8 | 04.2 | 68 | 57.7 | 36.0 | 128 | 108.6 | 67.8 | 188 | 159.4 | 99.6 | 248 | 210.3 | 131.4 |
| 9 | 07.6 | 04.8 | 69 | 58.5 | 36.6 | 129 | 109.4 | 68.4 | 189 | 160.3 | 100.2 | 249 | 211.2 | 131.9 |
| 10 | 08.5 | 05.3 | 70 | 59.4 | 37.1 | 130 | 110.2 | 68.9 | 190 | 161.1 | 100.7 | 250 | 212.0 | 132.5 |
| 11 | 09.3 | 05.8 | 71 | 60.2 | 37.6 | 131 | 111.1 | 69.4 | 191 | 162.0 | 101.2 | 251 | 212.9 | 133.0 |
| 12 | 10.2 | 06.4 | 72 | 61.1 | 38.2 | 132 | 111.9 | 69.9 | 192 | 162.8 | 101.7 | 252 | 213.7 | 133.5 |
| 13 | 11.0 | 06.9 | 73 | 61.9 | 38.7 | 133 | 112.8 | 70.5 | 193 | 163.7 | 102.3 | 253 | 214.6 | 134.1 |
| 14 | 11.9 | 07.4 | 74 | 62.8 | 39.2 | 134 | 113.6 | 71.0 | 194 | 164.5 | 102.8 | 254 | 215.4 | 134.6 |
| 15 | 12.7 | 07.9 | 75 | 63.6 | 39.7 | 135 | 114.5 | 71.5 | 195 | 165.4 | 103.3 | 255 | 216.3 | 135.1 |
| 16 | 13.6 | 08.5 | 76 | 64.5 | 40.3 | 136 | 115.3 | 72.1 | 196 | 166.2 | 103.9 | 256 | 217.1 | 135.7 |
| 17 | 14.4 | 09.0 | 77 | 65.3 | 40.8 | 137 | 116.2 | 72.6 | 197 | 167.1 | 104.4 | 257 | 217.9 | 136.2 |
| 18 | 15.3 | 09.5 | 78 | 66.1 | 41.3 | 138 | 117.0 | 73.1 | 198 | 167.9 | 104.9 | 258 | 218.8 | 136.7 |
| 19 | 16.1 | 10.1 | 79 | 67.0 | 41.9 | 139 | 117.9 | 73.7 | 199 | 168.8 | 105.5 | 259 | 219.6 | 137.2 |
| 20 | 17.0 | 10.6 | 80 | 67.8 | 42.4 | 140 | 118.7 | 74.2 | 200 | 169.6 | 106.0 | 260 | 220.5 | 137.8 |
| 21 | 17.8 | 11.1 | 81 | 68.7 | 42.9 | 141 | 119.6 | 74.7 | 201 | 170.5 | 106.5 | 261 | 221.3 | 138.3 |
| 22 | 18.7 | 11.7 | 82 | 69.5 | 43.5 | 142 | 120.4 | 75.2 | 202 | 171.3 | 107.0 | 262 | 222.2 | 138.8 |
| 23 | 19.5 | 12.2 | 83 | 70.4 | 44.0 | 143 | 121.3 | 75.8 | 203 | 172.2 | 107.6 | 263 | 223.0 | 139.4 |
| 24 | 20.4 | 12.7 | 84 | 71.2 | 44.5 | 144 | 122.1 | 76.3 | 204 | 173.0 | 108.1 | 264 | 223.9 | 139.9 |
| 25 | 21.2 | 13.2 | 85 | 72.1 | 45.0 | 145 | 123.0 | 76.8 | 205 | 173.8 | 108.6 | 265 | 224.7 | 140.4 |
| 26 | 22.0 | 13.8 | 86 | 72.9 | 45.6 | 146 | 123.8 | 77.4 | 206 | 174.7 | 109.2 | 266 | 225.6 | 141.0 |
| 27 | 22.9 | 14.3 | 87 | 73.8 | 46.1 | 147 | 124.7 | 77.9 | 207 | 175.5 | 109.7 | 267 | 226.4 | 141.5 |
| 28 | 23.7 | 14.8 | 88 | 74.6 | 46.6 | 148 | 125.5 | 78.4 | 208 | 176.4 | 110.2 | 268 | 227.3 | 142.0 |
| 29 | 24.6 | 15.4 | 89 | 75.5 | 47.2 | 149 | 126.4 | 79.0 | 209 | 177.2 | 110.8 | 269 | 228.1 | 142.5 |
| 30 | 25.4 | 15.9 | 90 | 76.3 | 47.7 | 150 | 127.2 | 79.5 | 210 | 178.1 | 111.3 | 270 | 229.0 | 143.1 |
| 31 | 26.3 | 16.4 | 91 | 77.2 | 48.2 | 151 | 128.1 | 80.0 | 211 | 178.9 | 111.8 | 271 | 229.8 | 143.6 |
| 32 | 27.1 | 17.0 | 92 | 78.0 | 48.8 | 152 | 128.9 | 80.5 | 212 | 179.8 | 112.3 | 272 | 230.7 | 144.1 |
| 33 | 28.0 | 17.5 | 93 | 78.9 | 49.3 | 153 | 129.8 | 81.1 | 213 | 180.6 | 112.9 | 273 | 231.5 | 144.7 |
| 34 | 28.8 | 18.0 | 94 | 79.7 | 49.8 | 154 | 130.6 | 81.6 | 214 | 181.5 | 113.4 | 274 | 232.4 | 145.2 |
| 35 | 29.7 | 18.5 | 95 | 80.6 | 50.3 | 155 | 131.4 | 82.1 | 215 | 182.3 | 113.9 | 275 | 233.2 | 145.7 |
| 36 | 30.5 | 19.1 | 96 | 81.4 | 50.9 | 156 | 132.3 | 82.7 | 216 | 183.2 | 114.5 | 276 | 234.1 | 146.3 |
| 37 | 31.4 | 19.6 | 97 | 82.3 | 51.4 | 157 | 133.1 | 83.2 | 217 | 184.0 | 115.0 | 277 | 234.9 | 146.8 |
| 38 | 32.2 | 20.1 | 98 | 83.1 | 51.9 | 158 | 134.0 | 83.7 | 218 | 184.9 | 115.5 | 278 | 235.8 | 147.3 |
| 39 | 33 1 | 20.7 | 99 | 84.0 | 52.5 | 159 | 134.8 | 84.3 | 219 | 185.7 | 116.1 | 279 | 236.6 | 147.8 |
| 40 | 33.9 | 21.2 | 100 | 84.8 | 53.0 | 160 | 135.7 | 84.8 | 220 | 186.6 | 116.6 | 280 | 237.5 | 148.4 |
| 41 | 34.8 | 21.7 | 101 | 85.7 | 53.5 | 161 | 136.5 | 85.3 | 221 | 187.4 | 117.1 | 281 | 238.3 | 148.9 |
| 42 | 35.6 | 22.3 | 102 | 86.5 | 54.1 | 162 | 137.4 | 85.8 | 222 | 188.3 | 117.6 | 282 | 239.1 | 149.4 |
| 43 | 36.5 | 22.8 | 103 | 87.3 | 54.6 | 163 | 138.2 | 86.4 | 223 | 189.1 | 118.2 | 283 | 240.0 | 150.0 |
| 44 | 37.3 | 23.3 | 104 | 88.2 | 55.1 | 164 | 139.1 | 86.9 | 224 | 190.0 | 118.7 | 284 | 240.8 | 150.5 |
| 45 | 38.2 | 23.8 | 105 | 89.0 | 55.6 | 165 | 139.9 | 87.4 | 225 | 190.8 | 119.2 | 285 | 241.7 | 151.0 |
| 46 | 39.0 | 24.4 | 106 | 89.9 | 56.2 | 166 | 140.8 | 88.0 | 226 | 191.7 | 119.8 | 286 | 242.5 | 151.6 |
| 47 | 39.9 | 24.9 | 107 | 90.7 | 56.7 | 167 | 141.6 | 88.5 | 227 | 192.5 | 120.3 | 287 | 243.4 | 152.1 |
| 48 | 40.7 | 25.4 | 108 | 91.6 | 57.2 | 168 | 142.5 | 89.0 | 228 | 193.4 | 120.8 | 288 | 244.2 | 152.6 |
| 49 | 41.6 | 26.0 | 109 | 92.4 | 57.8 | 169 | 143.3 | 89.6 | 229 | 194.2 | 121.4 | 289 | 245.1 | 153.1 |
| 50 | 42.4 | 26.5 | 110 | 93.3 | 58.3 | 170 | 144.2 | 90.1 | 230 | 195.1 | 121.9 | 290 | 245.9 | 153.7 |
| 51 | 43.3 | 27.0 | 111 | 94.1 | 58.8 | 171 | 145.0 | 90.6 | 231 | 195.9 | 122.4 | 291 | 246.8 | 154.2 |
| 52 | 44.1 | 27.6 | 112 | 95.0 | 59.4 | 172 | 145.9 | 91.1 | 232 | 196.7 | 122.9 | 292 | 247.6 | 154.7 |
| 53 | 44.9 | 28.1 | 113 | 95.8 | 59.9 | 173 | 146.7 | 91.7 | 233 | 197.6 | 123.5 | 293 | 248.5 | 155.3 |
| 54 | 45.8 | 28.6 | 114 | 96.7 | 60.4 | 174 | 147.6 | 92.2 | 234 | 198.4 | 124.0 | 294 | 249.3 | 155.8 |
| 55 | 46.6 | 29.1 | 115 | 97.5 | 60.9 | 175 | 148.4 | 92.7 | 235 | 199.3 | 124.5 | 295 | 250.2 | 156.3 |
| 56 | 47.5 | 29.7 | 116 | 98.4 | 61.5 | 176 | 149.3 | 93.3 | 236 | 200.1 | 125.1 | 296 | 251.0 | 156.9 |
| 57 | 48.3 | 30.2 | 117 | 99.2 | 62.0 | 177 | 150.1 | 93.8 | 237 | 201.0 | 125.6 | 297 | 251.9 | 157.4 |
| 58 | 49.2 | 30.7 | 118 | 100.1 | 62.5 | 178 | 151.0 | 94.3 | 238 | 201.8 | 126.1 | 298 | 252.7 | 157.9 |
| 59 | 50.0 | 31.3 | 119 | 100.9 | 63.1 | 179 | 151.8 | 94.9 | 239 | 202.7 | 126.7 | 299 | 253·6 | 158.4 |
| 60 | 50.9 | 31.8 | 120 | 101.8 | 63.6 | 180 | 152.6 | 95.4 | 240 | 203.5 | 127.2 | 300 | 254.4 | 159.0 |
| t. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 58 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 33 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.5 | 61 | 51.2 | 33.2 | 121 | 101.5 | 65.9 | 181 | 151.8 | 98.6 | 241 | 202.1 | 131.3 |
| 2 | 01.7 | 01.1 | 62 | 52.0 | 33.8 | 122 | 102.3 | 66.4 | 182 | 152.6 | 99.1 | 242 | 203.0 | 131.8 |
| 3 | 02.5 | 01.6 | 63 | 52.8 | 34.3 | 123 | 103.2 | 67.0 | 183 | 153.5 | 99.7 | 243 | 203.8 | 132.3 |
| 4 | 03.4 | 02.2 | 64 | 53.7 | 34.9 | 124 | 104.0 | 67.5 | 184 | 154.3 | 100.2 | 244 | 204.6 | 132.9 |
| 5 | 04.2 | 02.7 | 65 | 54.5 | 35.4 | 125 | 104.8 | 68.1 | 185 | 155.2 | 100.8 | 245 | 205.5 | 133.4 |
| 6 | 05.0 | 03.3 | 66 | 55.4 | 35.9 | 126 | 105.7 | 68.6 | 186 | 156.0 | 101.3 | 246 | 206.3 | 134.0 |
| 7 | 05.9 | 03.8 | 67 | 56.2 | 36.5 | 127 | 106.5 | 69.2 | 187 | 156.8 | 101.8 | 247 | 207.2 | 134.5 |
| 8 | 06.7 | 04.4 | 68 | 57.0 | 37.0 | 128 | 107.3 | 69.7 | 188 | 157.7 | 102.4 | 248 | 208.0 | 135.1 |
| 9 | 07.5 | 04.9 | 69 | 57.9 | 37.6 | 129 | 108.2 | 70.3 | 189 | 158.5 | 102.9 | 249 | 208.8 | 135.6 |
| 10 | 08.4 | 05.4 | 70 | 58.7 | 38.1 | 130 | 109.0 | 70.8 | 190 | 159.3 | 103.5 | 250 | 209.7 | 136.2 |
| 11 | 09.2 | 06.0 | 71 | 59.5 | 38.7 | 131 | 109.9 | 71.3 | 191 | 160.2 | 104.0 | 251 | 210.5 | 136.7 |
| 12 | 10.1 | 06.5 | 72 | 60.4 | 39.2 | 132 | 110.7 | 71.9 | 192 | 161.0 | 104.6 | 252 | 211.3 | 137.2 |
| 13 | 10.9 | 07.1 | 73 | 61.2 | 39.8 | 133 | 111.5 | 72.4 | 193 | 161.9 | 105.1 | 253 | 212.2 | 137.8 |
| 14 | 11.7 | 07.6 | 74 | 62.1 | 40.3 | 134 | 112.4 | 73.0 | 194 | 162.7 | 105.7 | 254 | 213.0 | 138.3 |
| 15 | 12.6 | 08.2 | 75 | 62.9 | 40.8 | 135 | 113.2 | 73.5 | 195 | 163.5 | 106.2 | 255 | 213.9 | 138.9 |
| 16 | 13.4 | 08.7 | 76 | 63.7 | 41.4 | 136 | 114.1 | 74.1 | 196 | 164.4 | 106.7 | 256 | 214.7 | 139.4 |
| 17 | 14.3 | 09.3 | 77 | 64.6 | 41.9 | 137 | 114.9 | 74.6 | 197 | 165.2 | 107.3 | 257 | 215.5 | 140.0 |
| 18 | 15.1 | 09.8 | 78 | 65.4 | 42.5 | 138 | 115.7 | 75.2 | 198 | 166.1 | 107.8 | 258 | 216.4 | 140.5 |
| 19 | 15.9 | 10.3 | 79 | 66.3 | 43.0 | 139 | 116.6 | 75.7 | 199 | 166.9 | 108.4 | 259 | 217.2 | 141.1 |
| 20 | 16.8 | 10.9 | 80 | 67.1 | 43.6 | 140 | 117.4 | 76.2 | 200 | 167.7 | 108.9 | 260 | 218.1 | 141.6 |
| 21 | 17.6 | 11.4 | 81 | 67.9 | 44.1 | 141 | 118.3 | 76.8 | 201 | 168.6 | 109.5 | 261 | 218.9 | 142.2 |
| 22 | 18.5 | 12.0 | 82 | 68.8 | 44.7 | 142 | 119.1 | 77.3 | 202 | 169.4 | 110.0 | 262 | 219.7 | 142.7 |
| 23 | 19.3 | 12.5 | 83 | 69.6 | 45.2 | 143 | 119.9 | 77.9 | 203 | 170.3 | 110.6 | 263 | 220.6 | 143.2 |
| 24 | 20.1 | 13.1 | 84 | 70.4 | 45.7 | 144 | 120.8 | 78.4 | 204 | 171.1 | 111.1 | 264 | 221.4 | 143.8 |
| 25 | 21.0 | 13.6 | 85 | 71.3 | 46.3 | 145 | 121.6 | 79.0 | 205 | 171.9 | 111.7 | 265 | 222.2 | 144.3 |
| 26 | 21.8 | 14.2 | 86 | 72.1 | 46.8 | 146 | 122.4 | 79.5 | 206 | 172.8 | 112.2 | 266 | 223.1 | 144.9 |
| 27 | 22.6 | 14.7 | 87 | 73.0 | 47.4 | 147 | 123.3 | 80.1 | 207 | 173.6 | 112.7 | 267 | 223.9 | 145.4 |
| 28 | 23.5 | 15.2 | 88 | 73.8 | 47.9 | 148 | 124.1 | 80.6 | 208 | 174.4 | 113.3 | 268 | 224.8 | 146.0 |
| 29 | 24.3 | 15.8 | 89 | 74.6 | 48.5 | 149 | 125.0 | 81.2 | 209 | 175.3 | 113.8 | 269 | 225.6 | 146.5 |
| 30 | 25.2 | 16.3 | 90 | 75.5 | 49.0 | 150 | 125.8 | 81.7 | 210 | 176.1 | 114.4 | 270 | 226.4 | 147.1 |
| 31 | 26.0 | 16.9 | 91 | 76.3 | 49.6 | 151 | 126.6 | 82.2 | 211 | 177.0 | 114.9 | 271 | 227.3 | 147.6 |
| 32 | 26.8 | 17.4 | 92 | 77.2 | 50.1 | 152 | 127.5 | 82.8 | 212 | 177.8 | 115.5 | 272 | 228.1 | 148.1 |
| 33 | 27.7 | 18.0 | 93 | 78.0 | 50.7 | 153 | 128.3 | 83.3 | 213 | 178.6 | 116.0 | 273 | 229.0 | 148.7 |
| 34 | 28.5 | 18.5 | 94 | 78.8 | 51.2 | 154 | 129.2 | 83.9 | 214 | 179.5 | 116.6 | 274 | 229.8 | 149.2 |
| 35 | 29.4 | 19.1 | 95 | 79.7 | 51.7 | 155 | 130.0 | 84.4 | 215 | 180.3 | 117.1 | 275 | 230.6 | 149.8 |
| 36 | 30.2 | 19.6 | 96 | 80.5 | 52.3 | 156 | 130.8 | 85.0 | 216 | 181.2 | 117.6 | 276 | 231.5 | 150.3 |
| 37 | 31.0 | 20.2 | 97 | 81.4 | 52.8 | 157 | 131.7 | 85.5 | 217 | 182.0 | 118.2 | 277 | 232.3 | 150.9 |
| 38 | 31.9 | 20.7 | 98 | 82.2 | 53.4 | 158 | 132.5 | 86.1 | 218 | 182.8 | 118.7 | 278 | 233.2 | 151.4 |
| 39 | 32.7 | 21.2 | 99 | 83.0 | 53.9 | 159 | 133.3 | 86.6 | 219 | 183.7 | 119.3 | 279 | 234.0 | 152.0 |
| 40 | 33.5 | 21.8 | 100 | 83.9 | 54.5 | 160 | 134.2 | 87.1 | 220 | 184.5 | 119.8 | 280 | 234.8 | 152.5 |
| 41 | 34.4 | 22.3 | 101 | 84.7 | 55.0 | 161 | 135.0 | 87.7 | 221 | 185.3 | 120.4 | 281 | 235.7 | 153.0 |
| 42 | 35.2 | 22.9 | 102 | 85.5 | 55.6 | 162 | 135.9 | 88.2 | 222 | 186.2 | 120.9 | 282 | 236.5 | 153.6 |
| 43 | 36.1 | 23.4 | 103 | 86.4 | 56.1 | 163 | 136.7 | 88.8 | 223 | 187.0 | 121.5 | 283 | 237.3 | 154.1 |
| 44 | 36.9 | 24.0 | 104 | 87.2 | 56.6 | 164 | 137.5 | 89.3 | 224 | 187.9 | 122.0 | 284 | 238.2 | 154.7 |
| 45 | 37.7 | 24.5 | 105 | 88.1 | 57.2 | 165 | 138.4 | 89.9 | 225 | 188.7 | 122.5 | 285 | 239.0 | 155.2 |
| 46 | 38.6 | 25.1 | 106 | 88.9 | 57.7 | 166 | 139.2 | 90.4 | 226 | 189.5 | 123.1 | 286 | 239.9 | 155.8 |
| 47 | 39.4 | 25.6 | 107 | 89.7 | 58.3 | 167 | 140.1 | 91.0 | 227 | 190.4 | 123.6 | 287 | 240.7 | 156.3 |
| 48 | 40.3 | 26.1 | 108 | 90.6 | 58.8 | 168 | 140.9 | 91.5 | 228 | 191.2 | 124.2 | 288 | 241.5 | 156.9 |
| 49 | 41.1 | 26.7 | 109 | 91.4 | 59.4 | 169 | 141.7 | 92.0 | 229 | 192.1 | 124.7 | 289 | 242.4 | 157.4 |
| 50 | 41.9 | 27.2 | 110 | 92.3 | 59.9 | 170 | 142.6 | 92.6 | 230 | 192.9 | 125.3 | 290 | 243.2 | 157.9 |
| 51 | 42.8 | 27.8 | 111 | 93.1 | 60.5 | 171 | 143.4 | 93.1 | 231 | 193.7 | 125.8 | 291 | 244.1 | 158.5 |
| 52 | 43.6 | 28.3 | 112 | 93.9 | 61.0 | 172 | 144.3 | 93.7 | 232 | 194.6 | 126.4 | 292 | 244.9 | 159.0 |
| 53 | 44.4 | 28.9 | 113 | 94.8 | 61.5 | 173 | 145.1 | 94.2 | 233 | 195.4 | 126.9 | 293 | 245.7 | 159.6 |
| 54 | 45.3 | 29.4 | 114 | 95.6 | 62.1 | 174 | 145.9 | 94.8 | 234 | 196.2 | 127.4 | 294 | 246.6 | 160.1 |
| 55 | 46.1 | 30.0 | 115 | 96.4 | 62.6 | 175 | 146.8 | 95.3 | 235 | 197.1 | 128.0 | 295 | 247.4 | 160.7 |
| 56 | 47.0 | 30.5 | 116 | 97.3 | 63.2 | 176 | 147.6 | 95.9 | 236 | 197.9 | 128.5 | 296 | 248.2 | 161.2 |
| 57 | 47.8 | 31.0 | 117 | 98.1 | 63.7 | 177 | 148.4 | 96.4 | 237 | 198.8 | 129.1 | 297 | 249.1 | 161.8 |
| 58 | 48.6 | 31.6 | 118 | 99.0 | 64.3 | 178 | 149.3 | 96.9 | 238 | 199.6 | 129.6 | 298 | 249.9 | 162.3 |
| 59 | 49.5 | 32.1 | 119 | 99.8 | 64.8 | 179 | 150.1 | 97.5 | 239 | 200.4 | 130.2 | 299 | 250.8 | 162.8 |
| 60 | 50.3 | 32.7 | 120 | 100.6 | 65.4 | 180 | 151.0 | 98.0 | 240 | 201.3 | 130.7 | 300 | 251.6 | 163.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |



For 57 Degrees.

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# TABLE II.

## Difference of Latitude and Departure for 34 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 50.6 | 34.1 | 121 | 100.3 | 67.7 | 181 | 150.1 | 101.2 | 241 | 199.8 | 134.8 |
| 2 | 01.7 | 01.1 | 62 | 51.4 | 34.7 | 122 | 101.1 | 68.2 | 182 | 150.9 | 101.8 | 242 | 200.6 | 135.3 |
| 3 | 02.5 | 01.7 | 63 | 52.2 | 35.2 | 123 | 102.0 | 68.8 | 183 | 151.7 | 102.3 | 243 | 201.5 | 135.9 |
| 4 | 03.3 | 02.2 | 64 | 53.1 | 35.8 | 124 | 102.8 | 69.3 | 184 | 152.5 | 102.9 | 244 | 202.3 | 136.4 |
| 5 | 04.1 | 02.8 | 65 | 53.9 | 36.3 | 125 | 103.6 | 69.9 | 185 | 153.4 | 103.5 | 245 | 203.1 | 137.0 |
| 6 | 05.0 | 03.4 | 66 | 54.7 | 36.9 | 126 | 104.5 | 70.5 | 186 | 154.2 | 104.0 | 246 | 203.9 | 137.6 |
| 7 | 05.8 | 03.9 | 67 | 55.5 | 37.5 | 127 | 105.3 | 71.0 | 187 | 155.0 | 104.6 | 247 | 204.8 | 138.1 |
| 8 | 06.6 | 04.5 | 68 | 56.4 | 38.0 | 128 | 106.1 | 71.6 | 188 | 155.9 | 105.1 | 248 | 205.6 | 138.7 |
| 9 | 07.5 | 05.0 | 69 | 57.2 | 38.6 | 129 | 106.9 | 72.1 | 189 | 156.7 | 105.7 | 249 | 206.4 | 139.2 |
| 10 | 08.3 | 05.6 | 70 | 58.0 | 39.1 | 130 | 107.8 | 72.7 | 190 | 157.5 | 106.2 | 250 | 207.3 | 139.8 |
| 11 | 09.1 | 06.2 | 71 | 58.9 | 39.7 | 131 | 108.6 | 73.3 | 191 | 158.3 | 106.8 | 251 | 208.1 | 140.4 |
| 12 | 09.9 | 06.7 | 72 | 59.7 | 40.3 | 132 | 109.4 | 73.8 | 192 | 159.2 | 107.4 | 252 | 208.9 | 140.9 |
| 13 | 10.8 | 07.3 | 73 | 60.5 | 40.8 | 133 | 110.3 | 74.4 | 193 | 160.0 | 107.9 | 253 | 209.7 | 141.5 |
| 14 | 11.6 | 07.8 | 74 | 61.3 | 41.4 | 134 | 111.1 | 74.9 | 194 | 160.8 | 108.5 | 254 | 210.6 | 142.0 |
| 15 | 12.4 | 08.4 | 75 | 62.2 | 41.9 | 135 | 111.9 | 75.5 | 195 | 161.7 | 109.0 | 255 | 211.4 | 142.6 |
| 16 | 13.3 | 08.9 | 76 | 63.0 | 42.5 | 136 | 112.7 | 76.1 | 196 | 162.5 | 109.6 | 256 | 212.2 | 143.2 |
| 17 | 14.1 | 09.5 | 77 | 63.8 | 43.1 | 137 | 113.6 | 76.6 | 197 | 163.3 | 110.2 | 257 | 213.1 | 143.7 |
| 18 | 14.9 | 10.1 | 78 | 64.7 | 43.6 | 138 | 114.4 | 77.2 | 198 | 164.1 | 110.7 | 258 | 213.9 | 144.3 |
| 19 | 15.8 | 10.6 | 79 | 65.5 | 44.2 | 139 | 115.2 | 77.7 | 199 | 165.0 | 111.3 | 259 | 214.7 | 144.8 |
| 20 | 16.6 | 11.2 | 80 | 66.3 | 44.7 | 140 | 116.1 | 78.3 | 200 | 165.8 | 111.8 | 260 | 215.5 | 145.4 |
| 21 | 17.4 | 11.7 | 81 | 67.2 | 45.3 | 141 | 116.9 | 78.8 | 201 | 166.6 | 112.4 | 261 | 216.4 | 145.9 |
| 22 | 18.2 | 12.3 | 82 | 68.0 | 45.9 | 142 | 117.7 | 79.4 | 202 | 167.5 | 113.0 | 262 | 217.2 | 146.5 |
| 23 | 19.1 | 12.9 | 83 | 68.8 | 46.4 | 143 | 118.6 | 80.0 | 203 | 168.3 | 113.5 | 263 | 218.0 | 147.1 |
| 24 | 19.9 | 13.4 | 84 | 69.6 | 47.0 | 144 | 119.4 | 80.5 | 204 | 169.1 | 114.1 | 264 | 218.9 | 147.6 |
| 25 | 20.7 | 14.0 | 85 | 70.5 | 47.5 | 145 | 120.2 | 81.1 | 205 | 170.0 | 114.6 | 265 | 219.7 | 148.2 |
| 26 | 21.6 | 14.5 | 86 | 71.3 | 48.1 | 146 | 121.0 | 81.6 | 206 | 170.8 | 115.2 | 266 | 220.5 | 148.7 |
| 27 | 22.4 | 15.1 | 87 | 72.1 | 48.6 | 147 | 121.9 | 82.2 | 207 | 171.6 | 115.8 | 267 | 221.4 | 149.3 |
| 28 | 23.2 | 15.7 | 88 | 73.0 | 49.2 | 148 | 122.7 | 82.8 | 208 | 172.4 | 116.3 | 268 | 222.2 | 149.9 |
| 29 | 24.0 | 16.2 | 89 | 73.8 | 49.8 | 149 | 123.5 | 83.3 | 209 | 173.3 | 116.9 | 269 | 223.0 | 150.4 |
| 30 | 24.9 | 16.8 | 90 | 74.6 | 50.3 | 150 | 124.4 | 83.9 | 210 | 174.1 | 117.4 | 270 | 223.8 | 151.0 |
| 31 | 25.7 | 17.3 | 91 | 75.4 | 50.9 | 151 | 125.2 | 84.4 | 211 | 174.9 | 118.0 | 271 | 224.7 | 151.5 |
| 32 | 26.5 | 17.9 | 92 | 76.3 | 51.4 | 152 | 126.0 | 85.0 | 212 | 175.8 | 118.5 | 272 | 225.5 | 152.1 |
| 33 | 27.4 | 18.5 | 93 | 77.1 | 52.0 | 153 | 126.8 | 85.6 | 213 | 176.6 | 119.1 | 273 | 226.3 | 152.7 |
| 34 | 28.2 | 19.0 | 94 | 77.9 | 52.6 | 154 | 127.7 | 86.1 | 214 | 177.4 | 119.7 | 274 | 227.2 | 153.2 |
| 35 | 29.0 | 19.6 | 95 | 78.8 | 53.1 | 155 | 128.5 | 86.7 | 215 | 178.2 | 120.2 | 275 | 228.0 | 153.8 |
| 36 | 29.8 | 20.1 | 96 | 79.6 | 53.7 | 156 | 129.3 | 87.2 | 216 | 179.1 | 120.8 | 276 | 228.8 | 154.3 |
| 37 | 30.7 | 20.7 | 97 | 80.4 | 54.2 | 157 | 130.2 | 87.8 | 217 | 179.9 | 121.3 | 277 | 229.6 | 154.9 |
| 38 | 31.5 | 21.2 | 98 | 81.2 | 54.8 | 158 | 131.0 | 88.4 | 218 | 180.7 | 121.9 | 278 | 230.5 | 155.5 |
| 39 | 32.3 | 21.8 | 99 | 82.1 | 55.4 | 159 | 131.8 | 88.9 | 219 | 181.6 | 122.5 | 279 | 231.3 | 156.0 |
| 40 | 33.2 | 22.4 | 100 | 82.9 | 55.9 | 160 | 132.6 | 89.5 | 220 | 182.4 | 123.0 | 280 | 232.1 | 156.6 |
| 41 | 34.0 | 22.9 | 101 | 83.7 | 56.5 | 161 | 133.5 | 90.0 | 221 | 183.2 | 123.6 | 281 | 233.0 | 157.1 |
| 42 | 34.8 | 23.5 | 102 | 84.6 | 57.0 | 162 | 134.3 | 90.6 | 222 | 184.0 | 124.1 | 282 | 233.8 | 157.7 |
| 43 | 35.6 | 24.0 | 103 | 85.4 | 57.6 | 163 | 135.1 | 91.1 | 223 | 184.9 | 124.7 | 283 | 234.6 | 158.3 |
| 44 | 36.5 | 24.6 | 104 | 86.2 | 58.2 | 164 | 136.0 | 91.7 | 224 | 185.7 | 125.3 | 284 | 235.4 | 158.8 |
| 45 | 37.3 | 25.2 | 105 | 87.0 | 58.7 | 165 | 136.8 | 92.3 | 225 | 186.5 | 125.8 | 285 | 236.3 | 159.4 |
| 46 | 38.1 | 25.7 | 106 | 87.9 | 59.3 | 166 | 137.6 | 92.8 | 226 | 187.4 | 126.4 | 286 | 237.1 | 159.9 |
| 47 | 39.0 | 26.3 | 107 | 88.7 | 59.8 | 167 | 138.4 | 93.4 | 227 | 188.2 | 126.9 | 287 | 237.9 | 160.5 |
| 48 | 39.8 | 26.8 | 108 | 89.5 | 60.4 | 168 | 139.3 | 93.9 | 228 | 189.0 | 127.5 | 288 | 238.8 | 161.0 |
| 49 | 40.6 | 27.4 | 109 | 90.4 | 61.0 | 169 | 140.1 | 94.5 | 229 | 189.8 | 128.1 | 289 | 239.6 | 161.6 |
| 50 | 41.5 | 28.0 | 110 | 91.2 | 61.5 | 170 | 140.9 | 95.1 | 230 | 190.7 | 128.6 | 290 | 240.4 | 162.2 |
| 51 | 42.3 | 28.5 | 111 | 92.0 | 62.1 | 171 | 141.8 | 95.6 | 231 | 191.5 | 129.2 | 291 | 241.2 | 162.7 |
| 52 | 43.1 | 29.1 | 112 | 92.9 | 62.6 | 172 | 142.6 | 96.2 | 232 | 192.3 | 129.7 | 292 | 242.1 | 163.3 |
| 53 | 43.9 | 29.6 | 113 | 93.7 | 63.2 | 173 | 143.4 | 96.7 | 233 | 193.2 | 130.3 | 293 | 242.9 | 163.8 |
| 54 | 44.8 | 30.2 | 114 | 94.5 | 63.7 | 174 | 144.3 | 97.3 | 234 | 194.0 | 130.9 | 294 | 243.7 | 164.4 |
| 55 | 45.6 | 30.8 | 115 | 95.3 | 64.3 | 175 | 145.1 | 97.9 | 235 | 194.8 | 131.4 | 295 | 244.6 | 165.0 |
| 56 | 46.4 | 31.3 | 116 | 96.2 | 64.9 | 176 | 145.9 | 98.4 | 236 | 195.7 | 132.0 | 296 | 245.4 | 165.5 |
| 57 | 47.3 | 31.9 | 117 | 97.0 | 65.4 | 177 | 146.7 | 99.0 | 237 | 196.5 | 132.5 | 297 | 246.2 | 166.1 |
| 58 | 48.1 | 32.4 | 118 | 97.8 | 66.0 | 178 | 147.6 | 99.5 | 238 | 197.3 | 133.1 | 298 | 247.1 | 166.6 |
| 59 | 48.9 | 33.0 | 119 | 98.7 | 66.5 | 179 | 148.4 | 100.1 | 239 | 198.1 | 133.6 | 299 | 247.9 | 167.2 |
| 60 | 49.7 | 33.6 | 120 | 99.5 | 67.1 | 180 | 149.2 | 100.7 | 240 | 199.0 | 134.2 | 300 | 248.7 | 167.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 56 Degrees.

## Difference of Latitude and Departure for 35 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 50.0 | 35.0 | 121 | 99.1 | 69.4 | 181 | 148.3 | 103.8 | 241 | 197.4 | 138.2 |
| 2 | 01.6 | 01.1 | 62 | 50.8 | 35.6 | 122 | 99.9 | 70.0 | 182 | 149.1 | 104.4 | 242 | 198.2 | 138.8 |
| 3 | 02.5 | 01.7 | 63 | 51.6 | 36.1 | 123 | 100.8 | 70.5 | 183 | 149.9 | 105.0 | 243 | 199.1 | 139.4 |
| 4 | 03.3 | 02.3 | 64 | 52.4 | 36.7 | 124 | 101.6 | 71.1 | 184 | 150.7 | 105.5 | 244 | 199.9 | 140.0 |
| 5 | 04.1 | 02.9 | 65 | 53.2 | 37.3 | 125 | 102.4 | 71.7 | 185 | 151.5 | 106.1 | 245 | 200.7 | 140.5 |
| 6 | 04.9 | 03.4 | 66 | 54.1 | 37.9 | 126 | 103.2 | 72.3 | 186 | 152.4 | 106.7 | 246 | 201.5 | 141.1 |
| 7 | 05.7 | 04.0 | 67 | 54.9 | 38.4 | 127 | 104.0 | 72.8 | 187 | 153.2 | 107.3 | 247 | 202.3 | 141.7 |
| 8 | 06.6 | 04.6 | 68 | 55.7 | 39.0 | 128 | 104.9 | 73.4 | 188 | 154.0 | 107.8 | 248 | 203.1 | 142.2 |
| 9 | 07.4 | 05.2 | 69 | 56.5 | 39.6 | 129 | 105.7 | 74.0 | 189 | 154.8 | 108.4 | 249 | 204.0 | 142.8 |
| 10 | 08.2 | 05.7 | 70 | 57.3 | 40.2 | 130 | 106.5 | 74.6 | 190 | 155.6 | 109.0 | 250 | 204.8 | 143.4 |
| 11 | 09.0 | 06.3 | 71 | 58.2 | 40.7 | 131 | 107.3 | 75.1 | 191 | 156.5 | 109.6 | 251 | 205.6 | 144.0 |
| 12 | 09.8 | 06.9 | 72 | 59.0 | 41.3 | 132 | 108.1 | 75.7 | 192 | 157.3 | 110.1 | 252 | 206.4 | 144.5 |
| 13 | 10.6 | 07.5 | 73 | 59.8 | 41.9 | 133 | 108.9 | 76.3 | 193 | 158.1 | 110.7 | 253 | 207.2 | 145.1 |
| 14 | 11.5 | 08.0 | 74 | 60.6 | 42.4 | 134 | 109.8 | 76.9 | 194 | 158.9 | 111.3 | 254 | 208.1 | 145.7 |
| 15 | 12.3 | 08.6 | 75 | 61.4 | 43.0 | 135 | 110.6 | 77.4 | 195 | 159.7 | 111.8 | 255 | 208.9 | 146.3 |
| 16 | 13.1 | 09.2 | 76 | 62.3 | 43.6 | 136 | 111.4 | 78.0 | 196 | 160.6 | 112.4 | 256 | 209.7 | 146.8 |
| 17 | 13.9 | 09.8 | 77 | 63.1 | 44.2 | 137 | 112.2 | 78.6 | 197 | 161.4 | 113.0 | 257 | 210.5 | 147.4 |
| 18 | 14.7 | 10.3 | 78 | 63.9 | 44.7 | 138 | 113.0 | 79.2 | 198 | 162.2 | 113.6 | 258 | 211.3 | 148.0 |
| 19 | 15.6 | 10.9 | 79 | 64.7 | 45.3 | 139 | 113.9 | 79.7 | 199 | 163.0 | 114.1 | 259 | 212.2 | 148.6 |
| 20 | 16.4 | 11.5 | 80 | 65.5 | 45.9 | 140 | 114.7 | 80.3 | 200 | 163.8 | 114.7 | 260 | 213.0 | 149.1 |
| 21 | 17.2 | 12.0 | 81 | 66.4 | 46.5 | 141 | 115.5 | 80.9 | 201 | 164.6 | 115.3 | 261 | 213.8 | 149.7 |
| 22 | 18.0 | 12.6 | 82 | 67.2 | 47.0 | 142 | 116.3 | 81.4 | 202 | 165.5 | 115.9 | 262 | 214.6 | 150.3 |
| 23 | 18.8 | 13.2 | 83 | 68.0 | 47.6 | 143 | 117.1 | 82.0 | 203 | 166.3 | 116.4 | 263 | 215.4 | 150.9 |
| 24 | 19.7 | 13.8 | 84 | 68.8 | 48.2 | 144 | 118.0 | 82.6 | 204 | 167.1 | 117.0 | 264 | 216.3 | 151.4 |
| 25 | 20.5 | 14.3 | 85 | 69.6 | 48.8 | 145 | 118.8 | 83.2 | 205 | 167.9 | 117.6 | 265 | 217.1 | 152.0 |
| 26 | 21.3 | 14.9 | 86 | 70.4 | 49.3 | 146 | 119.6 | 83.7 | 206 | 168.7 | 118.2 | 266 | 217.9 | 152.6 |
| 27 | 22.1 | 15.5 | 87 | 71.3 | 49.9 | 147 | 120.4 | 84.3 | 207 | 169.6 | 118.7 | 267 | 218.7 | 153.1 |
| 28 | 22.9 | 16.1 | 88 | 72.1 | 50.5 | 148 | 121.2 | 84.9 | 208 | 170.4 | 119.3 | 268 | 219.5 | 153.7 |
| 29 | 23.8 | 16.6 | 89 | 72.9 | 51.0 | 149 | 122.1 | 85.5 | 209 | 171.2 | 119.9 | 269 | 220.4 | 154.3 |
| 30 | 24.6 | 17.2 | 90 | 73.7 | 51.6 | 150 | 122.9 | 86.0 | 210 | 172.0 | 120.5 | 270 | 221.2 | 154.9 |
| 31 | 25.4 | 17.8 | 91 | 74.5 | 52.2 | 151 | 123.7 | 86.6 | 211 | 172.8 | 121.0 | 271 | 222.0 | 155.4 |
| 32 | 26.2 | 18.4 | 92 | 75.4 | 52.8 | 152 | 124.5 | 87.2 | 212 | 173.7 | 121.6 | 272 | 222.8 | 156.0 |
| 33 | 27.0 | 18.9 | 93 | 76.2 | 53.3 | 153 | 125.3 | 87.8 | 213 | 174.5 | 122.2 | 273 | 223.6 | 156.6 |
| 34 | 27.9 | 19.5 | 94 | 77.0 | 53.9 | 154 | 126.1 | 88.3 | 214 | 175.3 | 122.7 | 274 | 224.4 | 157.2 |
| 35 | 28.7 | 20.1 | 95 | 77.8 | 54.5 | 155 | 127.0 | 88.9 | 215 | 176.1 | 123.3 | 275 | 225.3 | 157.7 |
| 36 | 29.5 | 20.6 | 96 | 78.6 | 55.1 | 156 | 127.8 | 89.5 | 216 | 176.9 | 123.9 | 276 | 226.1 | 158.3 |
| 37 | 30.3 | 21.2 | 97 | 79.5 | 55.6 | 157 | 128.6 | 90.1 | 217 | 177.8 | 124.5 | 277 | 226.9 | 158.9 |
| 38 | 31.1 | 21.8 | 98 | 80.3 | 56.2 | 158 | 129.4 | 90.6 | 218 | 178.6 | 125.0 | 278 | 227.7 | 159.5 |
| 39 | 31.9 | 22.4 | 99 | 81.1 | 56.8 | 159 | 130.2 | 91.2 | 219 | 179.4 | 125.6 | 279 | 228.5 | 160.0 |
| 40 | 32.8 | 22.9 | 100 | 81.9 | 57.4 | 160 | 131.1 | 91.8 | 220 | 180.2 | 126.2 | 280 | 229.4 | 160.6 |
| 41 | 33.6 | 23.5 | 101 | 82.7 | 57.9 | 161 | 131.9 | 92.3 | 221 | 181.0 | 126.8 | 281 | 230.2 | 161.2 |
| 42 | 34.4 | 24.1 | 102 | 83.6 | 58.5 | 162 | 132.7 | 92.9 | 222 | 181.9 | 127.3 | 282 | 231.0 | 161.7 |
| 43 | 35.2 | 24.7 | 103 | 84.4 | 59.1 | 163 | 133.5 | 93.5 | 223 | 182.7 | 127.9 | 283 | 231.8 | 162.3 |
| 44 | 36.0 | 25.2 | 104 | 85.2 | 59.7 | 164 | 134.3 | 94.1 | 224 | 183.5 | 128.5 | 284 | 232.6 | 162.9 |
| 45 | 36.9 | 25.8 | 105 | 86.0 | 60.2 | 165 | 135.2 | 94.6 | 225 | 184.3 | 129.1 | 285 | 233.5 | 163.5 |
| 46 | 37.7 | 26.4 | 106 | 86.8 | 60.8 | 166 | 136.0 | 95.2 | 226 | 185.1 | 129.6 | 286 | 234.3 | 164.0 |
| 47 | 38.5 | 27.0 | 107 | 87.6 | 61.4 | 167 | 136.8 | 95.8 | 227 | 185.9 | 130.2 | 287 | 235.1 | 164.6 |
| 48 | 39.3 | 27.5 | 108 | 88.5 | 61.9 | 168 | 137.6 | 96.4 | 228 | 186.8 | 130.8 | 288 | 235.9 | 165.2 |
| 49 | 40.1 | 28.1 | 109 | 89.3 | 62.5 | 169 | 138.4 | 96.9 | 229 | 187.6 | 131.3 | 289 | 236.7 | 165.8 |
| 50 | 41.0 | 28.7 | 110 | 90.1 | 63.1 | 170 | 139.3 | 97.5 | 230 | 188.4 | 131.9 | 290 | 237.6 | 166.3 |
| 51 | 41.8 | 29.3 | 111 | 90.9 | 63.7 | 171 | 140.1 | 98.1 | 231 | 189.2 | 132.5 | 291 | 238.4 | 166.9 |
| 52 | 42.6 | 29.8 | 112 | 91.7 | 64.2 | 172 | 140·9 | 98.7 | 232 | 190.0 | 133.1 | 292 | 239.2 | 167.5 |
| 53 | 43.4 | 30.4 | 113 | 92.6 | 64.8 | 173 | 141.7 | 99.2 | 233 | 190.9 | 133.6 | 293 | 240.0 | 168.9 |
| 54 | 44.2 | 31.0 | 114 | 93.4 | 65.4 | 174 | 142.5 | 99.8 | 234 | 191.7 | 134.2 | 294 | 240.8 | 168.6 |
| 55 | 45.1 | 31.5 | 115 | 94.2 | 66.0 | 175 | 143.4 | 100.4 | 235 | 192.5 | 134.8 | 295 | 241.6 | 169.2 |
| 56 | 45.9 | 32.1 | 116 | 95.0 | 66.5 | 176 | 144.2 | 100.9 | 236 | 193.3 | 135.4 | 296 | 242.5 | 169.8 |
| 57 | 46.7 | 32.7 | 117 | 95.8 | 67.1 | 177 | 145.0 | 101.5 | 237 | 194.1 | 135.9 | 297 | 243.3 | 170.4 |
| 58 | 47.5 | 33.3 | 118 | 96.7 | 67.7 | 178 | 145.8 | 102.1 | 238 | 195.0 | 136.5 | 298 | 244.1 | 170.9 |
| 59 | 48.3 | 33.8 | 119 | 97.5 | 68.3 | 179 | 146.6 | 102.7 | 239 | 195.8 | 137.1 | 299 | 244.9 | 171.5 |
| 60 | 49.1 | 34.4 | 120 | 98.3 | 68.8 | 180 | 147.4 | 103.2 | 240 | 196.6 | 137.7 | 300 | 245.7 | 172.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 55 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 36 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 49.4 | 35.9 | 121 | 97.9 | 71.1 | 181 | 146.4 | 106.4 | 241 | 195.0 | 141.7 |
| 2 | 01.6 | 01.2 | 62 | 50.2 | 36.4 | 122 | 98.7 | 71.7 | 182 | 147.2 | 107.0 | 242 | 195.8 | 142.2 |
| 3 | 02.4 | 01.8 | 63 | 51.0 | 37.0 | 123 | 99.5 | 72.3 | 183 | 148.1 | 107.6 | 243 | 196.6 | 142.8 |
| 4 | 03.2 | 02.4 | 64 | 51.8 | 37.6 | 124 | 100.3 | 72.9 | 184 | 148.9 | 108.2 | 244 | 197.4 | 143.4 |
| 5 | 04.0 | 02.9 | 65 | 52.6 | 38.2 | 125 | 101.1 | 73.5 | 185 | 149.7 | 108.7 | 245 | 198.2 | 144.0 |
| 6 | 04.9 | 03.5 | 66 | 53.4 | 38.8 | 126 | 101.9 | 74.1 | 186 | 150.5 | 109.3 | 246 | 199.0 | 144.6 |
| 7 | 05.7 | 04.1 | 67 | 54.2 | 39.4 | 127 | 102.7 | 74.6 | 187 | 151.3 | 109.9 | 247 | 199.8 | 145.2 |
| 8 | 06.5 | 04.7 | 68 | 55.0 | 40.0 | 128 | 103.6 | 75.2 | 188 | 152.1 | 110.5 | 248 | 200.6 | 145.8 |
| 9 | 07.3 | 05.3 | 69 | 55.8 | 40.6 | 129 | 104.4 | 75.8 | 189 | 152.9 | 111.1 | 249 | 201.4 | 146.4 |
| 10 | 08.1 | 05.9 | 70 | 56.6 | 41.1 | 130 | 105.2 | 76.4 | 190 | 153.7 | 111.7 | 250 | 202.3 | 146.9 |
| 11 | 08.9 | 06.5 | 71 | 57.4 | 41.7 | 131 | 106.0 | 77.0 | 191 | 154.5 | 112.3 | 251 | 203.1 | 147.5 |
| 12 | 09.7 | 07.1 | 72 | 58.2 | 42.3 | 132 | 106.8 | 77.6 | 192 | 155.3 | 112.9 | 252 | 203.9 | 148.1 |
| 13 | 10.5 | 07.6 | 73 | 59.1 | 42.9 | 133 | 107.6 | 78.2 | 193 | 156.1 | 113.4 | 253 | 204.7 | 148.7 |
| 14 | 11.3 | 08.2 | 74 | 59.9 | 43.5 | 134 | 108.4 | 78.8 | 194 | 156.9 | 114.0 | 254 | 205.5 | 149 3 |
| 15 | 12.1 | 08.8 | 75 | 60.7 | 44.1 | 135 | 109.2 | 79.4 | 195 | 157.8 | 114.6 | 255 | 206.3 | 149.9 |
| 16 | 12.9 | 09.4 | 76 | 61.5 | 44.7 | 136 | 110.0 | 79.9 | 196 | 158.6 | 115.2 | 256 | 207.1 | 150.5 |
| 17 | 13.8 | 10.0 | 77 | 62.3 | 45.3 | 137 | 110.8 | 80.5 | 197 | 159.4 | 115.8 | 257 | 207.9 | 151.1 |
| 18 | 14.6 | 10.6 | 78 | 63.1 | 45.8 | 138 | 111.6 | 81.1 | 198 | 160.2 | 116.4 | 258 | 208.7 | 151.6 |
| 19 | 15.4 | 11.2 | 79 | 63.9 | 46.4 | 139 | 112.5 | 81.7 | 199 | 161.0 | 117.0 | 259 | 209.5 | 152.2 |
| 20 | 16.2 | 11.8 | 80 | 64.7 | 47.0 | 140 | 113.3 | 82.3 | 200 | 161.8 | 117.6 | 260 | 210.3 | 152.8 |
| 21 | 17.0 | 12.3 | 81 | 65.5 | 47.6 | 141 | 114.1 | 82.9 | 201 | 162.6 | 118.1 | 261 | 211.2 | 153.4 |
| 22 | 17.8 | 12.9 | 82 | 66.3 | 48.2 | 142 | 114.9 | 83.5 | 202 | 163.4 | 118.7 | 262 | 212.0 | 154.0 |
| 23 | 18.6 | 13.5 | 83 | 67.1 | 48.8 | 143 | 115.7 | 84.1 | 203 | 164.2 | 119.3 | 263 | 212.8 | 154.6 |
| 24 | 19.4 | 14.1 | 84 | 68.0 | 49.4 | 144 | 116.5 | 84.6 | 204 | 165.0 | 119.9 | 264 | 213.6 | 155.2 |
| 25 | 20.2 | 14.7 | 85 | 68.8 | 50.0 | 145 | 117.3 | 85.2 | 205 | 165.8 | 120.5 | 265 | 214.4 | 155.8 |
| 26 | 21.0 | 15.3 | 86 | 69.6 | 50.5 | 146 | 118.1 | 85.8 | 206 | 166.7 | 121.1 | 266 | 215.2 | 156.4 |
| 27 | 21.8 | 15.9 | 87 | 70.4 | 51.1 | 147 | 118.9 | 86.4 | 207 | 167.5 | 121.7 | 267 | 216.0 | 156.9 |
| 28 | 22.7 | 16.5 | 88 | 71.2 | 51.7 | 148 | 119.7 | 87.0 | 208 | 168.3 | 122.3 | 268 | 216.8 | 157.5 |
| 29 | 23.5 | 17.0 | 89 | 72.0 | 52.3 | 149 | 120.5 | 87.6 | 209 | 169.1 | 122.8 | 269 | 217.6 | 158.1 |
| 30 | 24.3 | 17.6 | 90 | 72.8 | 52.9 | 150 | 121.4 | 88.2 | 210 | 169.9 | 123.4 | 270 | 218.4 | 158.7 |
| 31 | 25.1 | 18.2 | 91 | 73.6 | 53.5 | 151 | 122.2 | 88.8 | 211 | 170.7 | 124.0 | 271 | 219.2 | 159.3 |
| 32 | 25.9 | 18.8 | 92 | 74.4 | 54.1 | 152 | 123.0 | 89.3 | 212 | 171.5 | 124.6 | 272 | 220.1 | 159.9 |
| 33 | 26.7 | 19.4 | 93 | 75.2 | 54.7 | 153 | 123.8 | 89.9 | 213 | 172.3 | 125.2 | 273 | 220.9 | 160.5 |
| 34 | 27.5 | 20.0 | 94 | 76.0 | 55.3 | 154 | 124.6 | 90.5 | 214 | 173.1 | 125.8 | 274 | 221.7 | 161.1 |
| 35 | 28.3 | 20.6 | 95 | 76.9 | 55.8 | 155 | 125.4 | 91.1 | 215 | 173.9 | 126.4 | 275 | 222.5 | 161.6 |
| 36 | 29.1 | 21.2 | 96 | 77.7 | 56.4 | 156 | 126.2 | 91.7 | 216 | 174.7 | 127.0 | 276 | 223.3 | 162.2 |
| 37 | 29.9 | 21.7 | 97 | 78.5 | 57.0 | 157 | 127.0 | 92.3 | 217 | 175.6 | 127.5 | 277 | 224.1 | 162.8 |
| 38 | 30.7 | 22.3 | 98 | 79.3 | 57.6 | 158 | 127.8 | 92.9 | 218 | 176.4 | 128.1 | 278 | 224.9 | 163.4 |
| 39 | 31.6 | 22.9 | 99 | 80.1 | 58.2 | 159 | 128.6 | 93.5 | 219 | 177.2 | 128.7 | 279 | 225.7 | 164.0 |
| 40 | 32.4 | 23.5 | 100 | 80.9 | 58.8 | 160 | 129.4 | 94.0 | 220 | 178.0 | 129.3 | 280 | 226.5 | 164.6 |
| 41 | 33.2 | 24.1 | 101 | 81.7 | 59.4 | 161 | 130.3 | 94.6 | 221 | 178.8 | 129.9 | 281 | 227.3 | 165.2 |
| 42 | 34.0 | 24.7 | 102 | 82.5 | 60.0 | 162 | 131.1 | 95.2 | 222 | 179.6 | 130.5 | 282 | 228.1 | 165.8 |
| 43 | 34.8 | 25.3 | 103 | 83.3 | 60.5 | 163 | 131.9 | 95.8 | 223 | 180.4 | 131.1 | 283 | 229.0 | 166.3 |
| 44 | 35.6 | 25.9 | 104 | 84.1 | 61.1 | 164 | 132.7 | 96.4 | 224 | 181.2 | 131.7 | 284 | 229.8 | 166.9 |
| 45 | 36.4 | 26.5 | 105 | 84.9 | 61.7 | 165 | 133.5 | 97.0 | 225 | 182.0 | 132.3 | 285 | 230.6 | 167.5 |
| 46 | 37.2 | 27.0 | 106 | 85.8 | 62.3 | 166 | 134.3 | 97.6 | 226 | 182.8 | 132.8 | 286 | 231.4 | 168.1 |
| 47 | 38.0 | 27.6 | 107 | 86.6 | 62.9 | 167 | 135.1 | 98.2 | 227 | 183.6 | 133.4 | 287 | 232.2 | 168.7 |
| 48 | 38.8 | 28.2 | 108 | 87.4 | 63.5 | 168 | 135.9 | 98.7 | 228 | 184.5 | 134.0 | 288 | 233.0 | 169.3 |
| 49 | 39.6 | 28.8 | 109 | 88.2 | 64.1 | 169 | 136.7 | 99.3 | 229 | 185.3 | 134.6 | 289 | 233.8 | 169.9 |
| 50 | 40.5 | 29.4 | 110 | 89.0 | 64.7 | 170 | 137.5 | 99.9 | 230 | 186.1 | 135.2 | 290 | 234.6 | 170.5 |
| 51 | 41.3 | 30.0 | 111 | 89.8 | 65.2 | 171 | 138.3 | 100.5 | 231 | 186.9 | 135.8 | 291 | 235.4 | 171.0 |
| 52 | 42.1 | 30.6 | 112 | 90.6 | 65.8 | 172 | 139.2 | 101.1 | 232 | 187.7 | 136.4 | 292 | 236.2 | 171.6 |
| 53 | 42.9 | 31.2 | 113 | 91.4 | 66.4 | 173 | 140.0 | 101.7 | 233 | 188.5 | 137.0 | 293 | 237.0 | 172.2 |
| 54 | 43.7 | 31.7 | 114 | 92.2 | 67.0 | 174 | 140.8 | 102.3 | 234 | 189.3 | 137.5 | 294 | 237.9 | 172.8 |
| 55 | 44.5 | 32.3 | 115 | 93.0 | 67.6 | 175 | 141.6 | 102.9 | 235 | 190.1 | 138.1 | 295 | 238.7 | 173.4 |
| 56 | 45.3 | 32.9 | 116 | 93.8 | 68.2 | 176 | 142.4 | 103.5 | 236 | 190.9 | 138.7 | 296 | 239.5 | 174.0 |
| 57 | 46.1 | 33.5 | 117 | 94.7 | 68.8 | 177 | 143.2 | 104.0 | 237 | 191.7 | 139.3 | 297 | 240.3 | 174.6 |
| 58 | 46.9 | 34.1 | 118 | 95.5 | 69.4 | 178 | 144.0 | 104.6 | 238 | 192.5 | 139.9 | 298 | 241.1 | 175.2 |
| 59 | 47.7 | 34.7 | 119 | 96.3 | 69.9 | 179 | 144.8 | 105.2 | 239 | 193.4 | 140.5 | 299 | 241.9 | 175.7 |
| 60 | 48.5 | 35.3 | 120 | 97.1 | 70.5 | 180 | 145.6 | 105.8 | 240 | 194.2 | 141.1 | 300 | 242.7 | 176.3 |

| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

For 54 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 37 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 48.7 | 36.7 | 121 | 96.6 | 72.8 | 181 | 144.6 | 108.9 | 241 | 192.5 | 145.0 |
| 2 | 01.6 | 01.2 | 62 | 49.5 | 37.3 | 122 | 97.4 | 73.4 | 182 | 145.4 | 109.5 | 242 | 193.3 | 145.6 |
| 3 | 02.4 | 01.8 | 63 | 50.3 | 37.9 | 123 | 98.2 | 74.0 | 183 | 146.2 | 110.1 | 243 | 194.1 | 146.2 |
| 4 | 03.2 | 02.4 | 64 | 51.1 | 38.5 | 124 | 99.0 | 74.6 | 184 | 146.9 | 110.7 | 244 | 194.9 | 146.8 |
| 5 | 04.0 | 03.0 | 65 | 51.9 | 39.1 | 125 | 99.8 | 75.2 | 185 | 147.7 | 111.3 | 245 | 195.7 | 147.4 |
| 6 | 04.8 | 03.6 | 66 | 52.7 | 39.7 | 126 | 100.6 | 75.8 | 186 | 148.5 | 111.9 | 246 | 196.5 | 148.0 |
| 7 | 05.6 | 04.2 | 67 | 53.5 | 40.3 | 127 | 101.4 | 76.4 | 187 | 149.3 | 112.5 | 247 | 197.3 | 148.6 |
| 8 | 06.4 | 04.8 | 68 | 54.3 | 40.9 | 128 | 102.2 | 77.0 | 188 | 150.1 | 113.1 | 248 | 198.1 | 149.3 |
| 9 | 07.2 | 05.4 | 69 | 55.1 | 41.5 | 129 | 103.0 | 77.6 | 189 | 150.9 | 113.7 | 249 | 198.9 | 149.9 |
| 10 | 08.0 | 06.0 | 70 | 55.9 | 42.1 | 130 | 103.8 | 78.2 | 190 | 151.7 | 114.3 | 250 | 199.7 | 150.5 |
| 11 | 08.8 | 06.6 | 71 | 56.7 | 42.7 | 131 | 104.6 | 78.8 | 191 | 152.5 | 114.9 | 251 | 200.5 | 151.1 |
| 12 | 09.6 | 07.2 | 72 | 57.5 | 43.3 | 132 | 105.4 | 79.4 | 192 | 153.3 | 115.5 | 252 | 201.3 | 151.7 |
| 13 | 10.4 | 07.8 | 73 | 58.3 | 43.9 | 133 | 106.2 | 80.0 | 193 | 154.1 | 116.2 | 253 | 202.1 | 152.3 |
| 14 | 11.2 | 08.4 | 74 | 59.1 | 44.5 | 134 | 107.0 | 80.6 | 194 | 154.9 | 116.8 | 254 | 202.9 | 152.9 |
| 15 | 12.0 | 09.0 | 75 | 59.9 | 45.1 | 135 | 107.8 | 81.2 | 195 | 155.7 | 117.4 | 255 | 203.7 | 153.5 |
| 16 | 12.8 | 09.6 | 76 | 60.7 | 45.7 | 136 | 108.6 | 81.8 | 196 | 156.5 | 118.0 | 256 | 204.5 | 154.1 |
| 17 | 13.6 | 10.2 | 77 | 61.5 | 46.3 | 137 | 109.4 | 82.4 | 197 | 157.3 | 118.6 | 257 | 205.2 | 154.7 |
| 18 | 14.4 | 10.8 | 78 | 62.3 | 46.9 | 138 | 110.2 | 83.1 | 198 | 158.1 | 119.2 | 258 | 206.0 | 155.3 |
| 19 | 15.2 | 11.4 | 79 | 63.1 | 47.5 | 139 | 111.0 | 83.7 | 199 | 158.9 | 119.8 | 259 | 206.8 | 155.9 |
| 20 | 16.0 | 12.0 | 80 | 63.9 | 48.1 | 140 | 111.8 | 84.3 | 200 | 159.7 | 120.4 | 260 | 207.6 | 156.5 |
| 21 | 16.8 | 12.6 | 81 | 64.7 | 48.7 | 141 | 112.6 | 84.9 | 201 | 160.5 | 121.0 | 261 | 208.4 | 157.1 |
| 22 | 17.6 | 13.2 | 82 | 65.5 | 49.3 | 142 | 113.4 | 85.5 | 202 | 161.3 | 121.6 | 262 | 209.2 | 157.7 |
| 23 | 18.4 | 13.8 | 83 | 66.3 | 50.0 | 143 | 114.2 | 86.1 | 203 | 162.1 | 122.2 | 263 | 210.0 | 158.3 |
| 24 | 19.2 | 14.4 | 84 | 67.1 | 50.6 | 144 | 115.0 | 86.7 | 204 | 162.9 | 122.8 | 264 | 210.8 | 158.9 |
| 25 | 20.0 | 15.0 | 85 | 67.9 | 51.2 | 145 | 115.8 | 87.3 | 205 | 163.7 | 123.4 | 265 | 211.6 | 159.5 |
| 26 | 20.8 | 15.6 | 86 | 68.7 | 51.8 | 146 | 116.6 | 87.9 | 206 | 164.5 | 124.0 | 266 | 212.4 | 160.1 |
| 27 | 21.6 | 16.2 | 87 | 69.5 | 52.4 | 147 | 117.4 | 88.5 | 207 | 165.3 | 124.6 | 267 | 213.2 | 160.7 |
| 28 | 22.4 | 16.9 | 88 | 70.3 | 53.0 | 148 | 118.2 | 89.1 | 208 | 166.1 | 125.2 | 268 | 214.0 | 161.3 |
| 29 | 23.2 | 17.5 | 89 | 71.1 | 53.6 | 149 | 119.0 | 89.7 | 209 | 166.9 | 125.8 | 269 | 214.8 | 161.9 |
| 30 | 24.0 | 18.1 | 90 | 71.9 | 54.2 | 150 | 119.8 | 90.3 | 210 | 167.7 | 126.4 | 270 | 215.6 | 162.5 |
| 31 | 24.8 | 18.7 | 91 | 72.7 | 54.8 | 151 | 120.6 | 90.9 | 211 | 168.5 | 127.0 | 271 | 216.4 | 163.1 |
| 32 | 25.6 | 19.3 | 92 | 73.5 | 55.4 | 152 | 121.4 | 91.5 | 212 | 169.3 | 127.6 | 272 | 217.2 | 163.7 |
| 33 | 26.4 | 19.9 | 93 | 74.3 | 56.0 | 153 | 122.2 | 92.1 | 213 | 170.1 | 128.2 | 273 | 218.0 | 164.3 |
| 34 | 27.2 | 20.5 | 94 | 75.1 | 56.6 | 154 | 123.0 | 92.7 | 214 | 170.9 | 128.8 | 274 | 218.8 | 164.9 |
| 35 | 28.0 | 21.1 | 95 | 75.9 | 57.2 | 155 | 123.8 | 93.3 | 215 | 171.7 | 129.4 | 275 | 219.6 | 165.5 |
| 36 | 28.8 | 21.7 | 96 | 76.7 | 57.8 | 156 | 124.6 | 93.9 | 216 | 172.5 | 130.0 | 276 | 220.4 | 166.1 |
| 37 | 29.5 | 22.3 | 97 | 77.5 | 58.4 | 157 | 125.4 | 94.5 | 217 | 173.3 | 130.6 | 277 | 221.2 | 166.7 |
| 38 | 30.3 | 22.9 | 98 | 78.3 | 59.0 | 158 | 126.2 | 95.1 | 218 | 174.1 | 131.2 | 278 | 222.0 | 167.3 |
| 39 | 31.1 | 23.5 | 99 | 79.1 | 59.6 | 159 | 127.0 | 95.7 | 219 | 174.9 | 131.8 | 279 | 222.8 | 167.9 |
| 40 | 31.9 | 24.1 | 100 | 79.9 | 60.2 | 160 | 127.8 | 96.3 | 220 | 175.7 | 132.4 | 280 | 223.6 | 168.5 |
| 41 | 32.7 | 24.7 | 101 | 80.7 | 60.8 | 161 | 128.6 | 96.9 | 221 | 176.5 | 133.0 | 281 | 224.4 | 169.1 |
| 42 | 33.5 | 25.3 | 102 | 81.5 | 61.4 | 162 | 129.4 | 97.5 | 222 | 177.3 | 133.6 | 282 | 225.2 | 169.7 |
| 43 | 34.3 | 25.9 | 103 | 82.3 | 62.0 | 163 | 130.2 | 98.1 | 223 | 178.1 | 134.2 | 283 | 226.0 | 170 3 |
| 44 | 35.1 | 26.5 | 104 | 83.1 | 62.6 | 164 | 131.0 | 98.7 | 224 | 178.9 | 134.8 | 284 | 226.8 | 170.9 |
| 45 | 35.9 | 27.1 | 105 | 83.9 | 63.2 | 165 | 131.8 | 99.3 | 225 | 179.7 | 135.4 | 285 | 227.6 | 171.5 |
| 46 | 36.7 | 27.7 | 106 | 84.7 | 63.8 | 166 | 132.6 | 99.9 | 226 | 180.5 | 136.0 | 286 | 228.4 | 172.1 |
| 47 | 37.5 | 28.3 | 107 | 85.5 | 64.4 | 167 | 133.4 | 100.5 | 227 | 181.3 | 136.6 | 287 | 229.2 | 172.7 |
| 48 | 38.3 | 28.9 | 108 | 86.3 | 65.0 | 168 | 134.2 | 101.1 | 228 | 182.1 | 137.2 | 288 | 230.0 | 173.3 |
| 49 | 39.1 | 29.5 | 109 | 87.1 | 65.6 | 169 | 135.0 | 101.7 | 229 | 182.9 | 137.8 | 289 | 230.8 | 173.7 |
| 50 | 39.9 | 30.1 | 110 | 87.8 | 66.2 | 170 | 135.8 | 102.3 | 230 | 183.7 | 138.4 | 290 | 231.6 | 174.5 |
| 51 | 40.7 | 30.7 | 111 | 88.6 | 66.8 | 171 | 136.6 | 102.9 | 231 | 184.5 | 139.0 | 291 | 232.4 | 175.1 |
| 52 | 41.5 | 31.3 | 112 | 89.4 | 67.4 | 172 | 137.4 | 103.5 | 232 | 185.3 | 139.6 | 292 | 233.2 | 175.7 |
| 53 | 42.3 | 31.9 | 113 | 90.2 | 68.0 | 173 | 138.2 | 104.1 | 233 | 186.1 | 140.2 | 293 | 234.0 | 176.3 |
| 54 | 43.1 | 32.5 | 114 | 91.0 | 68.6 | 174 | 139.0 | 104.7 | 234 | 186.9 | 140.8 | 294 | 234.8 | 176.9 |
| 55 | 43.9 | 33.1 | 115 | 91.8 | 69.2 | 175 | 139.8 | 105.3 | 235 | 187.7 | 141.4 | 295 | 235.6 | 177.5 |
| 56 | 44.7 | 33.7 | 116 | 92.6 | 69.8 | 176 | 140.6 | 105.9 | 236 | 188.5 | 142.0 | 296 | 236.4 | 178.1 |
| 57 | 45.5 | 34.3 | 117 | 93.4 | 70.4 | 177 | 141.4 | 106.5 | 237 | 189.3 | 142.6 | 297 | 237.2 | 178.7 |
| 58 | 46.3 | 34.9 | 118 | 94.2 | 71.0 | 178 | 142.2 | 107.1 | 238 | 190.1 | 143.2 | 298 | 238.0 | 179.3 |
| 59 | 47.1 | 35.5 | 119 | 95.0 | 71.6 | 179 | 143.0 | 107.7 | 239 | 190.9 | 143.3 | 299 | 238.8 | 179.9 |
| 60 | 47.9 | 36.1 | 120 | 95.8 | 72.2 | 180 | 143.8 | 108.3 | 240 | 191.7 | 144.4 | 300 | 239.6 | 180.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 38 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 48.1 | 37.6 | 121 | 95.3 | 74.5 | 181 | 142.6 | 111.4 | 241 | 189.9 | 148.4 |
| 2 | 01.6 | 01.2 | 62 | 48.9 | 38.2 | 122 | 96.1 | 75.1 | 182 | 143.4 | 112.1 | 242 | 190.7 | 149.0 |
| 3 | 02.4 | 01.8 | 63 | 49.6 | 38.8 | 123 | 96.9 | 75.7 | 183 | 144.2 | 112.7 | 243 | 191.5 | 149.6 |
| 4 | 03.2 | 02.5 | 64 | 50.4 | 39.4 | 124 | 97.7 | 76.3 | 184 | 145.0 | 113.3 | 244 | 192.3 | 150.2 |
| 5 | 03.9 | 03.1 | 65 | 51.2 | 40.0 | 125 | 98.5 | 77.0 | 185 | 145.8 | 113.9 | 245 | 193.1 | 150.8 |
| 6 | 04.7 | 03.7 | 66 | 52.0 | 40.6 | 126 | 99.3 | 77.6 | 186 | 146.6 | 114.5 | 246 | 193.9 | 151.5 |
| 7 | 05.5 | 04.3 | 67 | 52.8 | 41.2 | 127 | 100.1 | 78.2 | 187 | 147.4 | 115.1 | 247 | 194.6 | 152.1 |
| 8 | 06.3 | 04.9 | 68 | 53.6 | 41.9 | 128 | 100.9 | 78.8 | 188 | 148.1 | 115.7 | 248 | 195.4 | 152.7 |
| 9 | 07.1 | 05.5 | 69 | 54.4 | 42.5 | 129 | 101.7 | 79.4 | 189 | 148.9 | 116.4 | 249 | 196.2 | 153.3 |
| 10 | 07.9 | 06.2 | 70 | 55.2 | 43.1 | 130 | 102.4 | 80.0 | 190 | 149.7 | 117.0 | 250 | 197.0 | 153.9 |
| 11 | 08.7 | 06.8 | 71 | 55.9 | 43.7 | 131 | 103.2 | 80.7 | 191 | 150.5 | 117.6 | 251 | 197.8 | 154.5 |
| 12 | 09.5 | 07.4 | 72 | 56.7 | 44.3 | 132 | 104.0 | 81.3 | 192 | 151.3 | 118.2 | 252 | 198.6 | 155.1 |
| 13 | 10.2 | 08.0 | 73 | 57.5 | 44.9 | 133 | 104.8 | 81.9 | 193 | 152.1 | 118.8 | 253 | 199.4 | 155.8 |
| 14 | 11.0 | 08.6 | 74 | 58.3 | 45.6 | 134 | 105.6 | 82.5 | 194 | 152.9 | 119.4 | 254 | 200.2 | 156.4 |
| 15 | 11.8 | 09.2 | 75 | 59.1 | 46.2 | 135 | 106.4 | 83.1 | 195 | 153.7 | 120.1 | 255 | 200.9 | 157.0 |
| 16 | 12.6 | 09.9 | 76 | 59.9 | 46.8 | 136 | 107.2 | 83.7 | 196 | 154.5 | 120.7 | 256 | 201.7 | 157.6 |
| 17 | 13.4 | 10.5 | 77 | 60.7 | 47.4 | 137 | 108.0 | 84.3 | 197 | 155.2 | 121.3 | 257 | 202.5 | 158.2 |
| 18 | 14.2 | 11.1 | 78 | 61.5 | 48.0 | 138 | 108.7 | 85.0 | 198 | 156.0 | 121.9 | 258 | 203.3 | 158.8 |
| 19 | 15.0 | 11.7 | 79 | 62.3 | 48.6 | 139 | 109.5 | 85.6 | 199 | 156.8 | 122.5 | 259 | 204.1 | 159.5 |
| 20 | 15.8 | 12.3 | 80 | 63.0 | 49.3 | 140 | 110.3 | 86.2 | 200 | 157.6 | 123.1 | 260 | 204.9 | 160.1 |
| 21 | 16.5 | 12.9 | 81 | 63.8 | 49.9 | 141 | 111.1 | 86.8 | 201 | 158.4 | 123.7 | 261 | 205.7 | 160.7 |
| 22 | 17.3 | 13.5 | 82 | 64.6 | 50.5 | 142 | 111.9 | 87.4 | 202 | 159.2 | 124.4 | 262 | 206.5 | 161.3 |
| 23 | 18.1 | 14.2 | 83 | 65.4 | 51.1 | 143 | 112.7 | 88.0 | 203 | 160.0 | 125.0 | 263 | 207.2 | 161.9 |
| 24 | 18.9 | 14.8 | 84 | 66.2 | 51.7 | 144 | 113.5 | 88.7 | 204 | 160.8 | 125.6 | 264 | 208.0 | 162.5 |
| 25 | 19.7 | 15.4 | 85 | 67.0 | 52·3 | 145 | 114.3 | 89.3 | 205 | 161.5 | 126.2 | 265 | 208.8 | 163.2 |
| 26 | 20.5 | 16.0 | 86 | 67.8 | 52.9 | 146 | 115.0 | 89.9 | 206 | 162.3 | 126.8 | 266 | 209.6 | 163.8 |
| 27 | 21.3 | 16.6 | 87 | 68.6 | 53.6 | 147 | 115.8 | 90.5 | 207 | 163.1 | 127.4 | 267 | 210.4 | 164.4 |
| 28 | 22.1 | 17.2 | 88 | 69.3 | 54.2 | 148 | 116.6 | 91.1 | 208 | 163.9 | 128.1 | 268 | 211.2 | 165.0 |
| 29 | 22.9 | 17.9 | 89 | 70.1 | 54.8 | 149 | 117.4 | 91.7 | 209 | 164.7 | 128.7 | 269 | 212.0 | 165.6 |
| 30 | 23.6 | 18.5 | 90 | 70.9 | 55.4 | 150 | 118.2 | 92.3 | 210 | 165.5 | 129.3 | 270 | 212.8 | 166.2 |
| 31 | 24.4 | 19.1 | 91 | 71.7 | 56.0 | 151 | 119.0 | 93.0 | 211 | 166.3 | 129.9 | 271 | 213.6 | 166.8 |
| 32 | 25.2 | 19.7 | 92 | 72.5 | 56.6 | 152 | 119.8 | 93.6 | 212 | 167.1 | 130.5 | 272 | 214.3 | 167.5 |
| 33 | 26.0 | 20.3 | 93 | 73.3 | 57.3 | 153 | 120.6 | 94.2 | 213 | 167.8 | 131.1 | 273 | 215.1 | 168.1 |
| 34 | 26.8 | 20.9 | 94 | 74.1 | 57.9 | 154 | 121.4 | 94.8 | 214 | 168.6 | 131.8 | 274 | 215.9 | 168.7 |
| 35 | 27.6 | 21.5 | 95 | 74.9 | 58.5 | 155 | 122.1 | 95.4 | 215 | 169.4 | 132.4 | 275 | 216.7 | 169.3 |
| 36 | 28.4 | 22.2 | 96 | 75.6 | 59.1 | 156 | 122.9 | 96.0 | 216 | 170.2 | 133.0 | 276 | 217.5 | 169.9 |
| 37 | 29.2 | 22.8 | 97 | 76.4 | 59.7 | 157 | 123.7 | 96.7 | 217 | 171.0 | 133.6 | 277 | 218.3 | 170.5 |
| 38 | 29.9 | 23.4 | 98 | 77.2 | 60.3 | 158 | 124.5 | 97.3 | 218 | 171.8 | 134.2 | 278 | 219.1 | 171.2 |
| 39 | 30.7 | 24.0 | 99 | 78.0 | 61.0 | 159 | 125.3 | 97.9 | 219 | 172.6 | 134.8 | 279 | 219.9 | 171.8 |
| 40 | 31.5 | 24.6 | 100 | 78.8 | 61.6 | 160 | 126.1 | 98.5 | 220 | 173.4 | 135.4 | 280 | 220.6 | 172.4 |
| 41 | 32.3 | 25.2 | 101 | 79.6 | 62.2 | 161 | 126.9 | 99.1 | 221 | 174.2 | 136.1 | 281 | 221.4 | 173.0 |
| 42 | 33.1 | 25.9 | 102 | 80.4 | 62.8 | 162 | 127.7 | 99.7 | 222 | 174.9 | 136.7 | 282 | 222.2 | 173.6 |
| 43 | 33.9 | 26.5 | 103 | 81.2 | 63.4 | 163 | 128.4 | 100.4 | 223 | 175.7 | 137.3 | 283 | 223.0 | 174.2 |
| 44 | 34.7 | 27.1 | 104 | 82.0 | 64.0 | 164 | 129.2 | 101.0 | 224 | 176.5 | 137.9 | 284 | 223.8 | 174.8 |
| 45 | 35.5 | 27.7 | 105 | 82.7 | 64.6 | 165 | 130.0 | 101.6 | 225 | 177.3 | 138.5 | 285 | 224.6 | 175.5 |
| 46 | 36.2 | 28.3 | 106 | 83.5 | 65.3 | 166 | 130.8 | 102.2 | 226 | 178.1 | 139.1 | 286 | 225.4 | 176.1 |
| 47 | 37.0 | 28.9 | 107 | 84.3 | 65.9 | 167 | 131.6 | 102.8 | 227 | 178.9 | 139.8 | 287 | 226.2 | 176.7 |
| 48 | 37.8 | 29.6 | 108 | 85.1 | 66.5 | 168 | 132.4 | 103.4 | 228 | 179.7 | 140.4 | 288 | 226.9 | 177.3 |
| 49 | 38.6 | 30.2 | 109 | 85.9 | 67.1 | 169 | 133.2 | 104.0 | 229 | 180.5 | 141.0 | 289 | 227.7 | 177.9 |
| 50 | 39.4 | 30.8 | 110 | 86.7 | 67.7 | 170 | 134.0 | 104.7 | 230 | 181.2 | 141.6 | 290 | 228.5 | 178.5 |
| 51 | 40.2 | 31.4 | 111 | 87.5 | 68.3 | 171 | 134.7 | 105.3 | 231 | 182.0 | 142.2 | 291 | 229.3 | 179.2 |
| 52 | 41.0 | 32.0 | 112 | 88.3 | 69.0 | 172 | 135.5 | 105.9 | 232 | 182.8 | 142.8 | 292 | 230.1 | 179.8 |
| 53 | 41.8 | 32.6 | 113 | 89.0 | 69.6 | 173 | 136.3 | 106.5 | 233 | 183.6 | 143.4 | 293 | 230.9 | 180.4 |
| 54 | 42.6 | 33.2 | 114 | 89.8 | 70.2 | 174 | 137.1 | 107.1 | 234 | 184.4 | 144.1 | 294 | 231.7 | 181.0 |
| 55 | 43.3 | 33.9 | 115 | 90.6 | 70.8 | 175 | 137.9 | 107.7 | 235 | 185.2 | 144.7 | 295 | 232.5 | 181.6 |
| 56 | 44.1 | 34.5 | 116 | 91.4 | 71.4 | 176 | 138·7 | 108.4 | 236 | 186.0 | 145.3 | 296 | 233.3 | 182.2 |
| 57 | 44.9 | 35.1 | 117 | 92.2 | 72.0 | 177 | 139.5 | 109.0 | 237 | 186.8 | 145.9 | 297 | 234.0 | 182.9 |
| 58 | 45.7 | 35.7 | 118 | 93.0 | 72.6 | 178 | 140.3 | 109.6 | 238 | 187.5 | 146.5 | 298 | 234.8 | 183.5 |
| 59 | 46.5 | 36.3 | 119 | 93.8 | 73.3 | 179 | 141.1 | 110.2 | 239 | 188.3 | 147.1 | 299 | 235.6 | 184.1 |
| 60 | 47.3 | 36.9 | 120 | 94.6 | 73.9 | 180 | 141.8 | 110.8 | 240 | 189.1 | 147.8 | 300 | 236.4 | 184.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist | Dep. | Lat. | Dist. | Dep. | Lat. |

For 52 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 39 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 47.4 | 38.4 | 121 | 94.0 | 76.1 | 181 | 140.7 | 113.9 | 241 | 187.3 | 151.7 |
| 2 | 01.6 | 01.3 | 62 | 48.2 | 39.0 | 122 | 94.8 | 76.8 | 182 | 141.4 | 114.5 | 242 | 188.1 | 152.3 |
| 3 | 02.3 | 01.9 | 63 | 49.0 | 39.6 | 123 | 95.6 | 77.4 | 183 | 142.2 | 115.2 | 243 | 188.8 | 152.9 |
| 4 | 03.1 | 02.5 | 64 | 49.7 | 40.3 | 124 | 96.4 | 78.0 | 184 | 143.0 | 115.8 | 244 | 189.6 | 153.6 |
| 5 | 03.9 | 03.1 | 65 | 50.5 | 40.9 | 125 | 97.1 | 78.7 | 185 | 143.8 | 116.4 | 245 | 190.4 | 154.2 |
| 6 | 04.7 | 03.8 | 66 | 51.3 | 41.5 | 126 | 97.9 | 79.3 | 186 | 144.5 | 117.1 | 246 | 191.2 | 154.8 |
| 7 | 05.4 | 04.4 | 67 | 52.1 | 42.2 | 127 | 98.7 | 79.9 | 187 | 145.3 | 117.7 | 247 | 192.0 | 155.4 |
| 8 | 06.2 | 05.0 | 68 | 52.8 | 42.8 | 128 | 99.5 | 80.6 | 188 | 146.1 | 118.3 | 248 | 192.7 | 156.1 |
| 9 | 07.0 | 05.7 | 69 | 53.6 | 43.4 | 129 | 100.3 | 81.2 | 189 | 146.9 | 118.9 | 249 | 193.5 | 156.7 |
| 10 | 07.8 | 06.3 | 70 | 54.4 | 44.1 | 130 | 101.0 | 81.8 | 190 | 147.7 | 119.6 | 250 | 194.3 | 157.3 |
| 11 | 08.5 | 06.9 | 71 | 55.2 | 44.7 | 131 | 101.8 | 82.4 | 191 | 148.4 | 120.2 | 251 | 195.1 | 158.0 |
| 12 | 09.3 | 07.6 | 72 | 56.0 | 45.3 | 132 | 102.6 | 83.1 | 192 | 149.2 | 120.8 | 252 | 195.8 | 158.6 |
| 13 | 10.1 | 08.2 | 73 | 56.7 | 45.9 | 133 | 103.4 | 83.7 | 193 | 150.0 | 121.5 | 253 | 196.6 | 159.2 |
| 14 | 10.9 | 08.8 | 74 | 57.5 | 46.6 | 134 | 104.1 | 84.3 | 194 | 150.8 | 122.1 | 254 | 197.4 | 159.8 |
| 15 | 11.7 | 09.4 | 75 | 58.3 | 47.2 | 135 | 104.9 | 85.0 | 195 | 151.5 | 122.7 | 255 | 198.2 | 160.5 |
| 16 | 12.4 | 10.1 | 76 | 59.1 | 47.8 | 136 | 105.7 | 85.6 | 196 | 152.3 | 123.3 | 256 | 198.9 | 161.1 |
| 17 | 13.2 | 10.7 | 77 | 59.8 | 48.5 | 137 | 106.5 | 86.2 | 197 | 153.1 | 124.0 | 257 | 199.7 | 161.7 |
| 18 | 14.0 | 11.3 | 78 | 60.6 | 49.1 | 138 | 107.2 | 86.8 | 198 | 153.9 | 124.6 | 258 | 200.5 | 162.4 |
| 19 | 14.8 | 12.0 | 79 | 61.4 | 49.7 | 139 | 108.0 | 87.5 | 199 | 154.7 | 125.2 | 259 | 201.3 | 163.0 |
| 20 | 15.5 | 12.6 | 80 | 62.2 | 50.3 | 140 | 108.8 | 88.1 | 200 | 155.4 | 125.9 | 260 | 202.1 | 163.6 |
| 21 | 16.3 | 13.2 | 81 | 62.9 | 51.0 | 141 | 109.6 | 88.7 | 201 | 156.2 | 126.5 | 261 | 202.8 | 164.3 |
| 22 | 17.1 | 13.8 | 82 | 63.7 | 51.6 | 142 | 110.4 | 89.4 | 202 | 157.0 | 127.1 | 262 | 203.6 | 164.9 |
| 23 | 17.9 | 14.5 | 83 | 64.5 | 52.2 | 143 | 111.1 | 90.0 | 203 | 157.8 | 127.8 | 263 | 204.4 | 165.5 |
| 24 | 18.7 | 15.1 | 84 | 65.3 | 52.9 | 144 | 111.9 | 90.6 | 204 | 158.5 | 128.4 | 264 | 205.2 | 166.1 |
| 25 | 19.4 | 15.7 | 85 | 66.1 | 53.5 | 145 | 112.7 | 91.3 | 205 | 159.3 | 129.0 | 265 | 205.9 | 166.8 |
| 26 | 20.2 | 16.4 | 86 | 66.8 | 54.1 | 146 | 113.5 | 91.9 | 206 | 160.1 | 129.6 | 266 | 206.7 | 167.4 |
| 27 | 21.0 | 17.0 | 87 | 67.6 | 54.8 | 147 | 114.2 | 92.5 | 207 | 160.9 | 130.3 | 267 | 207.5 | 168.0 |
| 28 | 21.8 | 17.6 | 88 | 68.4 | 55.4 | 148 | 115.0 | 93.1 | 208 | 161.6 | 130.9 | 268 | 208.3 | 168.7 |
| 29 | 22.5 | 18.3 | 89 | 69.2 | 56.0 | 149 | 115.8 | 93.8 | 209 | 162.4 | 131.5 | 269 | 209.1 | 169.3 |
| 30 | 23.3 | 18.9 | 90 | 69.9 | 56.6 | 150 | 116.6 | 94.4 | 210 | 163.2 | 132.2 | 270 | 209.8 | 169.9 |
| 31 | 24.1 | 19.5 | 91 | 70.7 | 57.3 | 151 | 117.3 | 95.0 | 211 | 164.0 | 132.8 | 271 | 210.6 | 170.5 |
| 32 | 24.9 | 20.1 | 92 | 71.5 | 57.9 | 152 | 118.1 | 95.7 | 212 | 164.8 | 133.4 | 272 | 211.4 | 171.2 |
| 33 | 25.6 | 20.8 | 93 | 72.3 | 58.5 | 153 | 118.9 | 96.3 | 213 | 165.5 | 134.0 | 273 | 212.2 | 171.8 |
| 34 | 26.4 | 21.4 | 94 | 73.1 | 59.2 | 154 | 119.7 | 96.9 | 214 | 166.3 | 134.7 | 274 | 212.9 | 172.4 |
| 35 | 27.2 | 22.0 | 95 | 73.8 | 59.8 | 155 | 120.5 | 97.5 | 215 | 167.1 | 135.3 | 276 | 213.7 | 173.1 |
| 36 | 28.0 | 22.7 | 96 | 74.6 | 60.4 | 156 | 121.2 | 98.2 | 216 | 167.9 | 135.9 | 276 | 214.5 | 173.7 |
| 37 | 28.8 | 23.3 | 97 | 75.4 | 61.0 | 157 | 122.0 | 98.8 | 217 | 168.6 | 136.6 | 277 | 215.3 | 174.3 |
| 38 | 29.5 | 23.9 | 98 | 76.2 | 61.7 | 158 | 122.8 | 99.4 | 218 | 169.4 | 137.2 | 278 | 216.0 | 175.0 |
| 39 | 30.3 | 24.5 | 99 | 76.9 | 62.3 | 159 | 123.6 | 100.1 | 219 | 170.2 | 137.8 | 279 | 216.8 | 175.6 |
| 40 | 31.1 | 25.2 | 100 | 77.7 | 62.9 | 160 | 124.3 | 100.7 | 220 | 171.0 | 138.5 | 280 | 217.6 | 176.2 |
| 41 | 31.9 | 25.8 | 101 | 78.5 | 63.6 | 161 | 125.1 | 101.3 | 221 | 171.7 | 139.1 | 281 | 218.4 | 176.8 |
| 42 | 32.6 | 26.4 | 102 | 79.3 | 64.2 | 162 | 125.9 | 101.9 | 222 | 172.5 | 139.7 | 282 | 219.2 | 177.5 |
| 43 | 33.4 | 27.1 | 103 | 80.0 | 64.8 | 163 | 126.7 | 102.6 | 223 | 173.3 | 140.3 | 283 | 219.9 | 178.1 |
| 44 | 34.2 | 27.7 | 104 | 80.8 | 65.4 | 164 | 127.5 | 103.2 | 224 | 174.1 | 141.0 | 284 | 220.7 | 178.7 |
| 45 | 35.0 | 28.3 | 105 | 81.6 | 66.1 | 165 | 128.2 | 103.8 | 225 | 174.9 | 141.6 | 285 | 221.5 | 179.4 |
| 46 | 35.7 | 28.9 | 106 | 82.4 | 66.7 | 166 | 129.0 | 104.5 | 226 | 175.6 | 142.2 | 286 | 222.3 | 180.0 |
| 47 | 36.5 | 29.6 | 107 | 83.2 | 67.3 | 167 | 129.8 | 105.1 | 227 | 176.4 | 142.9 | 287 | 223.0 | 180.6 |
| 48 | 37.3 | 30.2 | 108 | 83.9 | 68.0 | 168 | 130.6 | 105.7 | 228 | 177.2 | 143.5 | 288 | 223.8 | 181.2 |
| 49 | 38.1 | 30.8 | 109 | 84.7 | 68.6 | 169 | 131.3 | 106.4 | 229 | 178.0 | 144.1 | 289 | 224.6 | 181.9 |
| 50 | 38.9 | 31.5 | 110 | 85.5 | 69.2 | 170 | 132.1 | 107.0 | 230 | 178.7 | 144.7 | 290 | 225.4 | 182.5 |
| 51 | 39.6 | 32.1 | 111 | 86.3 | 69.9 | 171 | 132.9 | 107.6 | 231 | 179.5 | 145.4 | 291 | 226.1 | 183.1 |
| 52 | 40.4 | 32.7 | 112 | 87.0 | 70.5 | 172 | 133.7 | 108.2 | 232 | 180.3 | 146.0 | 292 | 226.9 | 183.8 |
| 53 | 41.2 | 33.4 | 113 | 87.8 | 71.1 | 173 | 134.4 | 108.9 | 233 | 181.1 | 146.6 | 293 | 227.7 | 184.4 |
| 54 | 42.0 | 34.0 | 114 | 88.6 | 71.7 | 174 | 135.2 | 109.5 | 234 | 181.9 | 147.3 | 294 | 228.5 | 185.0 |
| 55 | 42.7 | 34.6 | 115 | 89.4 | 72.4 | 175 | 136.0 | 110.1 | 235 | 182.6 | 147.9 | 295 | 229.3 | 185.6 |
| 56 | 43.5 | 35.2 | 116 | 90.1 | 73.0 | 176 | 136.8 | 110.8 | 236 | 183.4 | 148.5 | 296 | 230.0 | 186.3 |
| 57 | 44.3 | 35.9 | 117 | 90.9 | 73.6 | 177 | 137.6 | 111.4 | 237 | 184.2 | 149.1 | 297 | 230.8 | 186.9 |
| 58 | 45.1 | 36.5 | 118 | 91.7 | 74.3 | 178 | 138.3 | 112.0 | 238 | 185.0 | 149.8 | 298 | 231.6 | 187.5 |
| 59 | 45.9 | 37.1 | 119 | 92.5 | 74.9 | 179 | 139.1 | 112.6 | 239 | 185.7 | 150.4 | 299 | 232.4 | 188.2 |
| 60 | 46.6 | 37.8 | 120 | 93.3 | 75.5 | 180 | 139.9 | 113.3 | 240 | 186.5 | 151.0 | 300 | 233.1 | 188.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 40 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.6 | 61 | 46.7 | 39.2 | 121 | 92.7 | 77.8 | 181 | 138.7 | 116.3 | 241 | 184.6 | 154.9 |
| 2 | 01.5 | 01.3 | 62 | 47.5 | 39.9 | 122 | 93.5 | 78.4 | 182 | 139.4 | 117.0 | 242 | 185.4 | 155.6 |
| 3 | 02.3 | 01.9 | 63 | 48.3 | 40.5 | 123 | 94.2 | 79.1 | 183 | 140.2 | 117.6 | 243 | 186.1 | 156.2 |
| 4 | 03.1 | 02.6 | 64 | 49.0 | 41.1 | 124 | 95.0 | 79.7 | 184 | 141.0 | 118.3 | 244 | 186.9 | 156.8 |
| 5 | 03.8 | 03.2 | 65 | 49.8 | 41.8 | 125 | 95.8 | 80.3 | 185 | 141.7 | 118.9 | 245 | 187.7 | 157.5 |
| 6 | 04.6 | 03.9 | 66 | 50.6 | 42.4 | 126 | 96.5 | 81.0 | 186 | 142.5 | 119.6 | 246 | 188.4 | 158.1 |
| 7 | 05.4 | 04.5 | 67 | 51.3 | 43.1 | 127 | 97.3 | 81.6 | 187 | 143.3 | 120.2 | 247 | 189.2 | 158.8 |
| 8 | 06.1 | 05.1 | 68 | 52.1 | 43.7 | 128 | 98.1 | 82.3 | 188 | 144.0 | 120.8 | 248 | 190.0 | 159.4 |
| 9 | 06.9 | 05.8 | 69 | 52.9 | 44.4 | 129 | 98.8 | 82.9 | 189 | 144.8 | 121.5 | 249 | 190.7 | 160.1 |
| 10 | 07.7 | 06.4 | 70 | 53.6 | 45.0 | 130 | 99.6 | 83.6 | 190 | 145.5 | 122.1 | 250 | 191.5 | 160.7 |
| 11 | 08.4 | 07.1 | 71 | 54.4 | 45.6 | 131 | 100.4 | 84.2 | 191 | 146.3 | 122.8 | 251 | 192.3 | 161.3 |
| 12 | 09.2 | 07.7 | 72 | 55.2 | 46.3 | 132 | 101.1 | 84.8 | 192 | 147.1 | 123.4 | 252 | 193.0 | 162.0 |
| 13 | 10.0 | 08.4 | 73 | 55.9 | 46.9 | 133 | 101.9 | 85.5 | 193 | 147.8 | 124.1 | 253 | 193.8 | 162.6 |
| 14 | 10.7 | 09.0 | 74 | 56.7 | 47.6 | 134 | 102.6 | 86.1 | 194 | 148.6 | 124.7 | 254 | 194.6 | 163.2 |
| 15 | 11.5 | 09.6 | 75 | 57.5 | 48.2 | 135 | 103.4 | 86.8 | 195 | 149.4 | 125.3 | 255 | 195.3 | 163.9 |
| 16 | 12.3 | 10.3 | 76 | 58.2 | 48.9 | 136 | 104.2 | 87.4 | 196 | 150.1 | 126.0 | 256 | 196.1 | 164.5 |
| 17 | 13.0 | 10.9 | 77 | 59.0 | 49.5 | 137 | 104.9 | 88.1 | 197 | 150.9 | 126.6 | 257 | 196.9 | 165.2 |
| 18 | 13.8 | 11.6 | 78 | 59.8 | 50.1 | 138 | 105.7 | 88.7 | 198 | 151.7 | 127.3 | 258 | 197.6 | 165.8 |
| 19 | 14.6 | 12.2 | 79 | 60.5 | 50.8 | 139 | 106.5 | 89.3 | 199 | 152.4 | 127.9 | 259 | 198.4 | 166.5 |
| 20 | 15.3 | 12.9 | 80 | 61.3 | 51.4 | 140 | 107.2 | 90.0 | 200 | 153.2 | 128.6 | 260 | 199.2 | 167.1 |
| 21 | 16.1 | 13.5 | 81 | 62.0 | 52.1 | 141 | 108.0 | 90.6 | 201 | 154.0 | 129.2 | 261 | 199.9 | 167.8 |
| 22 | 16.9 | 14.1 | 82 | 62.8 | 52.7 | 142 | 108.8 | 91.3 | 202 | 154.7 | 129.8 | 262 | 200.7 | 168.4 |
| 23 | 17.6 | 14.8 | 83 | 63.6 | 53.4 | 143 | 109.5 | 91.9 | 203 | 155.5 | 130.5 | 263 | 201.5 | 169.1 |
| 24 | 18.4 | 15.4 | 84 | 64.3 | 54.0 | 144 | 110.3 | 92.6 | 204 | 156.3 | 131.1 | 264 | 202.2 | 169.7 |
| 25 | 19.2 | 16.1 | 85 | 65.1 | 54.6 | 145 | 111.1 | 93.2 | 205 | 157.0 | 131.8 | 265 | 203.0 | 170.3 |
| 26 | 19.9 | 16.7 | 86 | 65.9 | 55.3 | 146 | 111.8 | 93.8 | 206 | 157.8 | 132.4 | 266 | 203.8 | 171.0 |
| 27 | 20.7 | 17.4 | 87 | 66.6 | 55.9 | 147 | 112.6 | 94.5 | 207 | 158.6 | 133.1 | 267 | 204.5 | 171.6 |
| 28 | 21.4 | 18.0 | 88 | 67.4 | 56.6 | 148 | 113.4 | 95.1 | 208 | 159.3 | 133.7 | 268 | 205.3 | 172.3 |
| 29 | 22.2 | 18.6 | 89 | 68.2 | 57.2 | 149 | 114.1 | 95.8 | 209 | 160.1 | 134.3 | 269 | 206.1 | 172.9 |
| 30 | 23.0 | 19.3 | 90 | 68.9 | 57.9 | 150 | 114.9 | 96.4 | 210 | 160.9 | 135.0 | 270 | 206.8 | 173.6 |
| 31 | 23.7 | 19.9 | 91 | 69.7 | 58.5 | 151 | 115.7 | 97.1 | 211 | 161.6 | 135.6 | 271 | 207.6 | 174.2 |
| 32 | 24.5 | 20.6 | 92 | 70.5 | 59.1 | 152 | 116.4 | 97.7 | 212 | 162.4 | 136.3 | 272 | 208.4 | 174.8 |
| 33 | 25.3 | 21.2 | 93 | 71.2 | 59.8 | 153 | 117.2 | 98.3 | 213 | 163.2 | 136.9 | 273 | 209.1 | 175.5 |
| 34 | 26.0 | 21.9 | 94 | 72.0 | 60.4 | 154 | 118.0 | 99.0 | 214 | 163.9 | 137.6 | 274 | 209.9 | 176.1 |
| 35 | 26.8 | 22.5 | 95 | 72.8 | 61.1 | 155 | 118.7 | 99.6 | 215 | 164.7 | 138.2 | 275 | 210.7 | 176.8 |
| 36 | 27.6 | 23.1 | 96 | 73.5 | 61.7 | 156 | 119.5 | 100.3 | 216 | 165.5 | 138.8 | 276 | 211.4 | 177.4 |
| 37 | 28.3 | 23.8 | 97 | 74.3 | 62.4 | 157 | 120.3 | 100.9 | 217 | 166.2 | 139.5 | 277 | 212.2 | 178.1 |
| 38 | 29.1 | 24.4 | 98 | 75.1 | 63.0 | 158 | 121.0 | 101.6 | 218 | 167.0 | 140.1 | 278 | 213.0 | 178.7 |
| 39 | 29.9 | 25.1 | 99 | 75.8 | 63.6 | 159 | 121.8 | 102.2 | 219 | 167.8 | 140.8 | 279 | 213.7 | 179.3 |
| 40 | 30.6 | 25.7 | 100 | 76.6 | 64.3 | 160 | 122.6 | 102.8 | 220 | 168.5 | 141.4 | 280 | 214.5 | 180.0 |
| 41 | 31.4 | 26.4 | 101 | 77.4 | 64.9 | 161 | 123.3 | 103.5 | 221 | 169.3 | 142.1 | 281 | 215.3 | 180.6 |
| 42 | 32.2 | 27.0 | 102 | 78.1 | 65.6 | 162 | 124.1 | 104.1 | 222 | 170.1 | 142.7 | 282 | 216.0 | 181.2 |
| 43 | 32.9 | 27.6 | 103 | 78.9 | 66.2 | 163 | 124.9 | 104.8 | 223 | 170.8 | 143.3 | 283 | 216.8 | 181.9 |
| 44 | 33.7 | 28.3 | 104 | 79.7 | 66.8 | 164 | 125.6 | 105.4 | 224 | 171.6 | 144.0 | 284 | 217.6 | 182.5 |
| 45 | 34.5 | 28.9 | 105 | 80.4 | 67.5 | 165 | 126.4 | 106.1 | 225 | 172.4 | 144.6 | 285 | 218.3 | 183.2 |
| 46 | 35.2 | 29.6 | 106 | 81.2 | 68.1 | 166 | 127.2 | 106.7 | 226 | 173.1 | 145.3 | 286 | 219.1 | 183.8 |
| 47 | 36.0 | 30.2 | 107 | 82.0 | 68.8 | 167 | 127.9 | 107.3 | 227 | 173.9 | 145.9 | 287 | 219.9 | 184.5 |
| 48 | 36.8 | 30.9 | 108 | 82.7 | 69.4 | 168 | 128.7 | 108.0 | 228 | 174.7 | 146.6 | 288 | 220.6 | 185.1 |
| 49 | 37.5 | 31.5 | 109 | 83.5 | 70.1 | 169 | 129.5 | 108.6 | 229 | 175.4 | 147.2 | 289 | 221.4 | 185.8 |
| 50 | 38.3 | 32.1 | 110 | 84.3 | 70.7 | 170 | 130.2 | 109.3 | 230 | 176.2 | 147.8 | 290 | 222.2 | 186.4 |
| 51 | 39.1 | 32.8 | 111 | 85.0 | 71.3 | 171 | 131.0 | 109.9 | 231 | 177.0 | 148.5 | 291 | 222.9 | 187.1 |
| 52 | 39.8 | 33.4 | 112 | 85.8 | 72.0 | 172 | 131.8 | 110.6 | 232 | 177.7 | 149.1 | 292 | 223.7 | 187.7 |
| 53 | 40.6 | 34.1 | 113 | 86.6 | 72.6 | 173 | 132.5 | 111.2 | 233 | 178.5 | 149.8 | 293 | 224.5 | 188.3 |
| 54 | 41.4 | 34.7 | 114 | 87.3 | 73.3 | 174 | 133.3 | 111.8 | 234 | 179.3 | 150.4 | 294 | 225.2 | 189.0 |
| 55 | 42.1 | 35.4 | 115 | 88.1 | 73.9 | 175 | 134.1 | 112.5 | 235 | 180.0 | 151.1 | 295 | 226.0 | 189.6 |
| 56 | 42.9 | 36.0 | 116 | 88.9 | 74.6 | 176 | 134.8 | 113.1 | 236 | 180.8 | 151.7 | 296 | 226.7 | 190.3 |
| 57 | 43.7 | 36.6 | 117 | 89.6 | 75.2 | 177 | 135.6 | 113.8 | 237 | 181.6 | 152.3 | 297 | 227.5 | 190.9 |
| 58 | 44.4 | 37.3 | 118 | 90.4 | 75.8 | 178 | 136.4 | 114.4 | 238 | 182.3 | 153.0 | 298 | 228.3 | 191.6 |
| 59 | 45.2 | 37.9 | 119 | 91.2 | 76.5 | 179 | 137.1 | 115.1 | 239 | 183.1 | 153.6 | 299 | 229.0 | 192.2 |
| 60 | 46.0 | 38.6 | 120 | 91.9 | 77.1 | 180 | 137.9 | 115.7 | 240 | 183.9 | 154.3 | 300 | 229.8 | 192.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

## Difference of Latitude and Departure for 41 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.8 | 00.7 | 61 | 46.0 | 40.0 | 121 | 91.3 | 79.4 | 181 | 136.6 | 118.7 | 241 | 181.9 | 158.1 |
| 2 | 01.5 | 01.3 | 62 | 46.8 | 40.7 | 122 | 92.1 | 80.0 | 182 | 137.4 | 119.4 | 242 | 182.6 | 158.8 |
| 3 | 02.3 | 02.0 | 63 | 47.5 | 41.3 | 123 | 92.8 | 80.7 | 183 | 138.1 | 120.1 | 243 | 183.4 | 159.4 |
| 4 | 03.0 | 02.6 | 64 | 48.3 | 42.0 | 124 | 93.6 | 81.4 | 184 | 138.9 | 120.7 | 244 | 184.1 | 160.1 |
| 5 | 03.8 | 03.3 | 65 | 49.1 | 42.6 | 125 | 94.3 | 82.0 | 185 | 139.6 | 121.4 | 245 | 184.9 | 160.7 |
| 6 | 04.5 | 03.9 | 66 | 49.8 | 43.3 | 126 | 95.1 | 82.7 | 186 | 140.4 | 122.0 | 246 | 185.7 | 161.4 |
| 7 | 05.3 | 04.6 | 67 | 50.6 | 44.0 | 127 | 95.8 | 83.3 | 187 | 141.1 | 122.7 | 247 | 186.4 | 162.0 |
| 8 | 06.0 | 05.2 | 68 | 51.3 | 44.6 | 128 | 96.6 | 84.0 | 188 | 141.9 | 123.3 | 248 | 187.2 | 162.7 |
| 9 | 06.8 | 05.9 | 69 | 52.1 | 45.3 | 129 | 97.4 | 84.6 | 189 | 142.6 | 124.0 | 249 | 187.9 | 163.4 |
| 10 | 07.5 | 06.6 | 70 | 52.8 | 45.9 | 130 | 98.1 | 85.3 | 190 | 143.4 | 124.7 | 250 | 188.7 | 164.0 |
| 11 | 08.3 | 07.2 | 71 | 53.6 | 46.6 | 131 | 98.9 | 85.9 | 191 | 144.1 | 125.3 | 251 | 189.4 | 164.7 |
| 12 | 09.1 | 07.9 | 72 | 54.3 | 47.2 | 132 | 99.6 | 86.6 | 192 | 144.9 | 126.0 | 252 | 190.2 | 165.3 |
| 13 | 09.8 | 08.5 | 73 | 55.1 | 47.9 | 133 | 100.4 | 87.3 | 193 | 145.7 | 126.6 | 253 | 190.9 | 166.0 |
| 14 | 10.6 | 09.2 | 74 | 55.8 | 48.5 | 134 | 101.1 | 87.9 | 194 | 146.4 | 127.3 | 254 | 191.7 | 166.6 |
| 15 | 11.3 | 09.8 | 75 | 56.6 | 49.2 | 135 | 101.9 | 88.6 | 195 | 147.2 | 127.9 | 255 | 192.5 | 167.3 |
| 16 | 12.1 | 10.5 | 76 | 57.4 | 49.9 | 136 | 102.6 | 89.2 | 196 | 147.9 | 128.6 | 256 | 193.2 | 168.0 |
| 17 | 12.8 | 11.2 | 77 | 58.1 | 50.5 | 137 | 103.4 | 89.9 | 197 | 148.7 | 129.2 | 257 | 194.0 | 168.6 |
| 18 | 13.6 | 11.8 | 78 | 58.9 | 51.2 | 138 | 104.1 | 90.5 | 198 | 149.4 | 129.9 | 258 | 194.7 | 169.3 |
| 19 | 14.3 | 12.5 | 79 | 59.6 | 51.8 | 139 | 104.9 | 91.2 | 199 | 150.2 | 130.6 | 259 | 195.5 | 169.9 |
| 20 | 15.1 | 13.1 | 80 | 60.4 | 52.5 | 140 | 105.7 | 91.8 | 200 | 150.9 | 131.2 | 260 | 196.2 | 170.6 |
| 21 | 15.8 | 13.8 | 81 | 61.1 | 53.1 | 141 | 106.4 | 92.5 | 201 | 151.7 | 131.9 | 261 | 197.0 | 171.2 |
| 22 | 16.6 | 14.4 | 82 | 61.9 | 53.8 | 142 | 107.2 | 93.2 | 202 | 152.5 | 132.5 | 262 | 197.7 | 171.9 |
| 23 | 17.4 | 15.1 | 83 | 62.6 | 54.5 | 143 | 107.9 | 93.8 | 203 | 153.2 | 133.2 | 263 | 198.5 | 172.5 |
| 24 | 18.1 | 15.7 | 84 | 63.4 | 55.1 | 144 | 108.7 | 94.5 | 204 | 154.0 | 133.8 | 264 | 199.2 | 173.2 |
| 25 | 18.9 | 16.4 | 85 | 64.2 | 55.8 | 145 | 109.4 | 95.1 | 205 | 154.7 | 134.5 | 265 | 200.0 | 173.9 |
| 26 | 19.6 | 17.1 | 86 | 64.9 | 56.4 | 146 | 110.2 | 95.8 | 206 | 155.5 | 135.1 | 266 | 200.8 | 174.5 |
| 27 | 20.4 | 17.7 | 87 | 65.7 | 57.1 | 147 | 110.9 | 96.4 | 207 | 156.2 | 135.8 | 267 | 201.5 | 175.2 |
| 28 | 21.1 | 18.4 | 88 | 66.4 | 57.7 | 148 | 111.7 | 97.1 | 208 | 157.0 | 136.5 | 268 | 202.3 | 175.8 |
| 29 | 21.9 | 19.0 | 89 | 67.2 | 58.4 | 149 | 112.5 | 97.8 | 209 | 157.7 | 137.1 | 269 | 203.0 | 176.5 |
| 30 | 22.6 | 19.7 | 90 | 67.9 | 59.0 | 150 | 113.2 | 98.4 | 210 | 158.5 | 137.8 | 270 | 203.8 | 177.1 |
| 31 | 23.4 | 20.3 | 91 | 68.7 | 59.7 | 151 | 114.0 | 99.1 | 211 | 159.2 | 138.4 | 271 | 204.5 | 177.8 |
| 32 | 24.2 | 21.0 | 92 | 69.4 | 60.4 | 152 | 114.7 | 99.7 | 212 | 160.0 | 139.1 | 272 | 205.3 | 178.4 |
| 33 | 24.9 | 21.6 | 93 | 70.2 | 61.0 | 153 | 115.5 | 100.4 | 213 | 160.8 | 139.7 | 273 | 206.0 | 179.1 |
| 34 | 25.7 | 22.3 | 94 | 70.9 | 61.7 | 154 | 116.2 | 101.0 | 214 | 161.5 | 140.4 | 274 | 206.8 | 179.8 |
| 35 | 26.4 | 23.0 | 95 | 71.7 | 62.3 | 155 | 117.0 | 101.7 | 215 | 162.3 | 141.1 | 275 | 207.5 | 180.4 |
| 36 | 27.2 | 23.6 | 96 | 72.5 | 63.0 | 156 | 117.7 | 102.3 | 216 | 163.0 | 141.7 | 276 | 208.3 | 181.1 |
| 37 | 27.9 | 24.3 | 97 | 73.2 | 63.6 | 157 | 118.5 | 103.0 | 217 | 163.8 | 142.4 | 277 | 209.1 | 181.7 |
| 38 | 28.7 | 24.9 | 98 | 74.0 | 64.3 | 158 | 119.2 | 103.7 | 218 | 164.5 | 143.0 | 278 | 209.8 | 182.4 |
| 39 | 29.4 | 25.6 | 99 | 74.7 | 64.9 | 159 | 120.0 | 104.3 | 219 | 165.3 | 143.7 | 279 | 210.6 | 183.0 |
| 40 | 30.2 | 26.2 | 100 | 75.5 | 65.6 | 160 | 120.8 | 105.0 | 220 | 166.0 | 144.3 | 280 | 211.3 | 183.7 |
| 41 | 30.9 | 26.9 | 101 | 76.2 | 66.3 | 161 | 121.5 | 105.6 | 221 | 166.8 | 145.0 | 281 | 212.1 | 184.4 |
| 42 | 31.7 | 27.6 | 102 | 77.0 | 66.9 | 162 | 122.3 | 106.3 | 222 | 167.5 | 145.6 | 282 | 212.8 | 185 0 |
| 43 | 32.5 | 28.2 | 103 | 77.7 | 67.6 | 163 | 123.0 | 106.9 | 223 | 168.3 | 146.3 | 283 | 213.6 | 185.7 |
| 44 | 33.2 | 28.9 | 104 | 78.5 | 68.2 | 164 | 123.8 | 107.6 | 224 | 169.1 | 147.0 | 284 | 214.3 | 186.3 |
| 45 | 34.0 | 29.5 | 105 | 79.2 | 68.9 | 165 | 124.5 | 108.2 | 225 | 169.8 | 147.6 | 285 | 215.1 | 187.0 |
| 46 | 34.7 | 30.2 | 106 | 80.0 | 69.5 | 166 | 125.3 | 108.9 | 226 | 170.6 | 148.3 | 286 | 215.8 | 187.6 |
| 47 | 35.5 | 30.8 | 107 | 80.8 | 70.2 | 167 | 126.0 | 109.6 | 227 | 171.3 | 148.9 | 287 | 216.6 | 188.3 |
| 48 | 36.2 | 31.5 | 108 | 81.5 | 70.9 | 168 | 126.8 | 110.2 | 228 | 172.1 | 149.6 | 288 | 217.4 | 188.9 |
| 49 | 37.0 | 32.1 | 109 | 82.3 | 71.5 | 169 | 127.5 | 110.9 | 229 | 172.8 | 150.2 | 289 | 218.1 | 189.6 |
| 50 | 37.7 | 32.8 | 110 | 83.0 | 72.2 | 170 | 128.3 | 111.5 | 230 | 173.6 | 150.9 | 290 | 218.9 | 190.2 |
| 51 | 38.5 | 33.5 | 111 | 83.8 | 72.8 | 171 | 129.1 | 112.2 | 231 | 174.3 | 151.5 | 291 | 219.6 | 190.9 |
| 52 | 39.2 | 34.1 | 112 | 84.5 | 73.5 | 172 | 129.8 | 112.8 | 232 | 175.1 | 152.2 | 292 | 220.4 | 191.6 |
| 53 | 40.0 | 34.8 | 113 | 85.3 | 74.1 | 173 | 130.6 | 113.5 | 233 | 175.8 | 152.9 | 293 | 221.1 | 192.2 |
| 54 | 40.8 | 35.4 | 114 | 86.0 | 74.8 | 174 | 131.3 | 114.2 | 234 | 176.6 | 153.5 | 294 | 221.9 | 192.9 |
| 55 | 41.5 | 36.1 | 115 | 86.8 | 75.4 | 175 | 132.1 | 114.8 | 235 | 177.4 | 154.2 | 295 | 222.6 | 193.5 |
| 56 | 42.3 | 36.7 | 116 | 87.5 | 76.1 | 176 | 132.8 | 115.5 | 236 | 178.1 | 154.8 | 296 | 223.4 | 194.2 |
| 57 | 43.0 | 37.4 | 117 | 88.3 | 76.8 | 177 | 133.6 | 116.1 | 237 | 178.9 | 155.5 | 297 | 224.1 | 194.8 |
| 58 | 43.8 | 38.1 | 118 | 89.1 | 77.4 | 178 | 134.3 | 116.8 | 238 | 179.6 | 156.1 | 298 | 224.9 | 195.5 |
| 59 | 44.5 | 38.7 | 119 | 89.8 | 78.1 | 179 | 135.1 | 117.4 | 239 | 180.4 | 156.8 | 299 | 225.7 | 196.2 |
| 60 | 45.3 | 39.4 | 120 | 90.6 | 78.7 | 180 | 135.8 | 118.1 | 240 | 181.1 | 157.5 | 300 | 226.4 | 196.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE II.

## Difference of Latitude and Departure for 42 Degrees

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.7 | 00.7 | 61 | 45.3 | 40.8 | 121 | 89.9 | 81.0 | 181 | 134.5 | 121.1 | 241 | 179.1 | 161.3 |
| 2 | 01.5 | 01.3 | 62 | 46.1 | 41.5 | 122 | 90.7 | 81.6 | 182 | 135.3 | 121.8 | 242 | 179.8 | 161.9 |
| 3 | 02.2 | 02.0 | 63 | 46.8 | 42.2 | 123 | 91.4 | 82.3 | 183 | 136.0 | 122.5 | 243 | 180.6 | 162.6 |
| 4 | 03.0 | 02.7 | 64 | 47.6 | 42.8 | 124 | 92.1 | 83.0 | 184 | 136.7 | 123.1 | 244 | 181.3 | 163.3 |
| 5 | 03.7 | 03.3 | 65 | 48.3 | 43.5 | 125 | 92.9 | 83.6 | 185 | 137.5 | 123.8 | 245 | 182.1 | 163.9 |
| 6 | 04.5 | 04.0 | 66 | 49.0 | 44.2 | 126 | 93.6 | 84.3 | 186 | 138.2 | 124.5 | 246 | 182.8 | 164.6 |
| 7 | 05.2 | 04.7 | 67 | 49.8 | 44.8 | 127 | 94.4 | 85.0 | 187 | 139.0 | 125.1 | 247 | 183.6 | 165.3 |
| 8 | 05.9 | 05.4 | 68 | 50.5 | 45.5 | 128 | 95.1 | 85.6 | 188 | 139.7 | 125.8 | 248 | 184.3 | 165.9 |
| 9 | 06.7 | 06.0 | 69 | 51.3 | 46.2 | 129 | 95.9 | 86.3 | 189 | 140.5 | 126.5 | 249 | 185.0 | 166.6 |
| 10 | 07.4 | 06.7 | 70 | 52.0 | 46.8 | 130 | 96.6 | 87.0 | 190 | 141.2 | 127.1 | 250 | 185.8 | 167.3 |
| 11 | 08.2 | 07.4 | 71 | 52.8 | 47.5 | 131 | 97.4 | 87.7 | 191 | 141.9 | 127.8 | 251 | 186.5 | 168.0 |
| 12 | 08.9 | 08.0 | 72 | 53.5 | 48.2 | 132 | 98.1 | 88.3 | 192 | 142.7 | 128.5 | 252 | 187.3 | 168.6 |
| 13 | 09.7 | 08.7 | 73 | 54.2 | 48.8 | 133 | 98.8 | 89.0 | 193 | 143.4 | 129.1 | 253 | 188.0 | 169.3 |
| 14 | 10.4 | 09.4 | 74 | 55.0 | 49.5 | 134 | 99.6 | 89.7 | 194 | 144.2 | 129.8 | 254 | 188.8 | 170.0 |
| 15 | 11.1 | 10.0 | 75 | 55.7 | 50.2 | 135 | 100.3 | 90.3 | 195 | 144.9 | 130.5 | 255 | 189.5 | 170.6 |
| 16 | 11.9 | 10.7 | 76 | 56.5 | 50.9 | 136 | 101.1 | 91.0 | 196 | 145.7 | 131.1 | 256 | 190.2 | 171.3 |
| 17 | 12.6 | 11.4 | 77 | 57.2 | 51.5 | 137 | 101.8 | 91.7 | 197 | 146.4 | 131.8 | 257 | 191.0 | 172.0 |
| 18 | 13.4 | 12.0 | 78 | 58.0 | 52.2 | 138 | 102.6 | 92.3 | 198 | 147.1 | 132.5 | 258 | 191.7 | 172.6 |
| 19 | 14.1 | 12.7 | 79 | 58.7 | 52.9 | 139 | 103.3 | 93.0 | 199 | 147.9 | 133.2 | 259 | 192.5 | 173.3 |
| 20 | 14.9 | 13.4 | 80 | 59.5 | 53.5 | 140 | 104.0 | 93.7 | 200 | 148.6 | 133.8 | 260 | 193.2 | 174.0 |
| 21 | 15.6 | 14.1 | 81 | 60.2 | 54.2 | 141 | 104.8 | 94.3 | 201 | 149.4 | 134.5 | 261 | 194.0 | 174.6 |
| 22 | 16.3 | 14.7 | 82 | 60.9 | 54.9 | 142 | 105.5 | 95.0 | 202 | 150.1 | 135.2 | 262 | 194.7 | 175.3 |
| 23 | 17.1 | 15.4 | 83 | 61.7 | 55.5 | 143 | 106.3 | 95.7 | 203 | 150.9 | 135.8 | 263 | 195.4 | 176.0 |
| 24 | 17.8 | 16.1 | 84 | 62.4 | 56.2 | 144 | 107.0 | 96.4 | 204 | 151.6 | 136.5 | 264 | 196.2 | 176.7 |
| 25 | 18.6 | 16.7 | 85 | 63.2 | 56.9 | 145 | 107.8 | 97.0 | 205 | 152.3 | 137.2 | 265 | 196.9 | 177.3 |
| 26 | 19.3 | 17.4 | 86 | 63.9 | 57.5 | 146 | 108.5 | 97.7 | 206 | 153.1 | 137.8 | 266 | 197.7 | 178.0 |
| 27 | 20.1 | 18.1 | 87 | 64.7 | 58.2 | 147 | 109.2 | 98.4 | 207 | 153.8 | 138.5 | 267 | 198.4 | 178.7 |
| 28 | 20.8 | 18.7 | 88 | 65.4 | 58.9 | 148 | 110.0 | 99.0 | 208 | 154.6 | 139.2 | 268 | 199.2 | 179.3 |
| 29 | 21.6 | 19.4 | 89 | 66.1 | 59.6 | 149 | 110.7 | 99.7 | 209 | 155.3 | 139.8 | 269 | 199.9 | 180.0 |
| 30 | 22.3 | 20.1 | 90 | 66.9 | 60.2 | 150 | 111.5 | 100.4 | 210 | 156.1 | 140.5 | 270 | 200.6 | 180.7 |
| 31 | 23.0 | 20.7 | 91 | 67.6 | 60.9 | 151 | 112.2 | 101.0 | 211 | 156.8 | 141.2 | 271 | 201.4 | 181.3 |
| 32 | 23.8 | 21.4 | 92 | 68.4 | 61.6 | 152 | 113.0 | 101.7 | 212 | 157.5 | 141.9 | 272 | 202.1 | 182.0 |
| 33 | 24.5 | 22.1 | 93 | 69.1 | 62.2 | 153 | 113.7 | 102.4 | 213 | 158.3 | 142.5 | 273 | 202.9 | 182.7 |
| 34 | 25.3 | 22.8 | 94 | 69.9 | 62.9 | 154 | 114.4 | 103.0 | 214 | 159.0 | 143.2 | 274 | 203.6 | 183.3 |
| 35 | 26.0 | 23.4 | 95 | 70.6 | 63.6 | 155 | 115.2 | 103.7 | 215 | 159.8 | 143.9 | 275 | 204.4 | 184.0 |
| 36 | 26.8 | 24.1 | 96 | 71.3 | 64.2 | 156 | 115.9 | 104.4 | 216 | 160.5 | 144.5 | 276 | 205.1 | 184.7 |
| 37 | 27.5 | 24.8 | 97 | 72.1 | 64.9 | 157 | 116.7 | 105.1 | 217 | 161.3 | 145.2 | 277 | 205.9 | 185.3 |
| 38 | 28.2 | 25.4 | 98 | 72.8 | 65.6 | 158 | 117.4 | 105.7 | 218 | 162.0 | 145.9 | 278 | 206.6 | 186.0 |
| 39 | 29.0 | 26.1 | 99 | 73.6 | 66.2 | 159 | 118.2 | 106.4 | 219 | 162.7 | 146.5 | 279 | 207.3 | 186.7 |
| 40 | 29.7 | 26.8 | 100 | 74.3 | 66.9 | 160 | 118.9 | 107.1 | 220 | 163.5 | 147.2 | 280 | 208.1 | 187.4 |
| 41 | 30.5 | 27.4 | 101 | 75.1 | 67.6 | 161 | 119.6 | 107.7 | 221 | 164.2 | 147.9 | 281 | 208.8 | 188.0 |
| 42 | 31.2 | 28.1 | 102 | 75.8 | 68.3 | 162 | 120.4 | 108.4 | 222 | 165.0 | 148.5 | 282 | 209.6 | 188.7 |
| 43 | 32.0 | 28.8 | 103 | 76.5 | 68.9 | 163 | 121.1 | 109.1 | 223 | 165.7 | 149.2 | 283 | 210.3 | 189.4 |
| 44 | 32.7 | 29.4 | 104 | 77.3 | 69.6 | 164 | 121.9 | 109.7 | 224 | 166.5 | 149.9 | 284 | 211.1 | 190.0 |
| 45 | 33.4 | 30.1 | 105 | 78.0 | 70.3 | 165 | 122.6 | 110.4 | 225 | 167.2 | 150.6 | 285 | 211.8 | 190.7 |
| 46 | 34.2 | 30.8 | 106 | 78.8 | 70.9 | 166 | 123.4 | 111.1 | 226 | 168.0 | 151.2 | 286 | 212.5 | 191.4 |
| 47 | 34.9 | 31.4 | 107 | 79.5 | 71.6 | 167 | 124.1 | 111.7 | 227 | 168.7 | 151.9 | 287 | 213.3 | 192.0 |
| 48 | 35.7 | 32.1 | 108 | 80.3 | 72.3 | 168 | 124.8 | 112.4 | 228 | 169.4 | 152.6 | 288 | 214.0 | 192.7 |
| 49 | 36.4 | 32.8 | 109 | 81.0 | 72.9 | 169 | 125.6 | 113.1 | 229 | 170.2 | 153.2 | 289 | 214.8 | 193.4 |
| 50 | 37.2 | 33.5 | 110 | 81.7 | 73.6 | 170 | 126.3 | 113.8 | 230 | 170.9 | 153.9 | 290 | 215.5 | 194.0 |
| 51 | 37.9 | 34.1 | 111 | 82.5 | 74.3 | 171 | 127.1 | 114.4 | 231 | 171.7 | 154.6 | 291 | 216.3 | 194.7 |
| 52 | 38.6 | 34.8 | 112 | 83.2 | 74.9 | 172 | 127.8 | 115.1 | 232 | 172.4 | 155.2 | 292 | 217.0 | 195.4 |
| 53 | 39.4 | 35.5 | 113 | 84.0 | 75.6 | 173 | 128.6 | 115.8 | 233 | 173.2 | 155.9 | 293 | 217.7 | 196.1 |
| 54 | 40.1 | 36.1 | 114 | 84.7 | 76.3 | 174 | 129.3 | 116.4 | 234 | 173.9 | 156.6 | 294 | 218.5 | 196.7 |
| 55 | 40.9 | 36.8 | 115 | 85.5 | 77.0 | 175 | 130.1 | 117.1 | 235 | 174.6 | 157.2 | 295 | 219.2 | 197.4 |
| 56 | 41.6 | 37.5 | 116 | 86.2 | 77.6 | 176 | 130.8 | 117.8 | 236 | 175.4 | 157.9 | 296 | 220.0 | 198.1 |
| 57 | 42.4 | 38.1 | 117 | 86.9 | 78.3 | 177 | 131.5 | 118.4 | 237 | 176.1 | 158.6 | 297 | 220.7 | 198.7 |
| 58 | 43.1 | 38.8 | 118 | 87.7 | 79.0 | 178 | 132.3 | 119.1 | 238 | 176.9 | 159.3 | 298 | 221.5 | 199.4 |
| 59 | 43.8 | 39.5 | 119 | 88.4 | 79.6 | 179 | 133.0 | 119.8 | 239 | 177.6 | 159.9 | 299 | 222.2 | 200.1 |
| 60 | 44.6 | 40.1 | 120 | 89.2 | 80.3 | 180 | 133.8 | 120.4 | 240 | 178.4 | 160.6 | 300 | 222.9 | 200.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

## Difference of Latitude and Departure for 43 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.7 | 00.7 | 61 | 44.6 | 41.6 | 121 | 88.5 | 82.5 | 181 | 132.4 | 123.4 | 241 | 176.3 | 164.4 |
| 2 | 01.5 | 01.4 | 62 | 45.3 | 42.3 | 122 | 89.2 | 83.2 | 182 | 133.1 | 124.1 | 242 | 177.0 | 165.0 |
| 3 | 02.2 | 02.0 | 63 | 46.1 | 43.0 | 123 | 90.0 | 83.9 | 183 | 133.8 | 124.8 | 243 | 177.7 | 165.7 |
| 4 | 02.9 | 02.7 | 64 | 46.8 | 43.6 | 124 | 90.7 | 84.6 | 184 | 134.6 | 125.5 | 244 | 178.5 | 166.4 |
| 5 | 03.7 | 03.4 | 65 | 47.5 | 44.3 | 125 | 91.4 | 85.2 | 185 | 135.3 | 126.2 | 245 | 179.2 | 167.1 |
| 6 | 04.4 | 04.1 | 66 | 48.3 | 45.0 | 126 | 92.2 | 85.9 | 186 | 136.0 | 126.9 | 246 | 179.9 | 167.8 |
| 7 | 05.1 | 04.8 | 67 | 49.0 | 45.7 | 127 | 92.9 | 86.6 | 187 | 136.8 | 127.5 | 247 | 180.6 | 168.5 |
| 8 | 05.9 | 05.5 | 68 | 49.7 | 46.4 | 128 | 93.6 | 87.3 | 188 | 137.5 | 128.2 | 248 | 181.4 | 169.1 |
| 9 | 06.6 | 06.1 | 69 | 50.5 | 47.1 | 129 | 94.3 | 88.0 | 189 | 138.2 | 128.9 | 249 | 182.1 | 169.8 |
| 10 | 07.3 | 06.8 | 70 | 51.2 | 47.7 | 130 | 95.1 | 88.7 | 190 | 139.0 | 129.6 | 250 | 182.8 | 170.5 |
| 11 | 08.0 | 07.5 | 71 | 51.9 | 48.4 | 131 | 95.8 | 89.3 | 191 | 139.7 | 130.3 | 251 | 183.6 | 171.2 |
| 12 | 08.8 | 08.2 | 72 | 52.7 | 49.1 | 132 | 96.5 | 90.0 | 192 | 140.4 | 130.9 | 252 | 184.3 | 171.9 |
| 13 | 09.5 | 08.9 | 73 | 53.4 | 49.8 | 133 | 97.3 | 90.7 | 193 | 141.2 | 131.6 | 253 | 185.0 | 172.5 |
| 14 | 10.2 | 09.5 | 74 | 54.1 | 50.5 | 134 | 98.0 | 91.4 | 194 | 141.9 | 132.3 | 254 | 185.8 | 173.2 |
| 15 | 11.0 | 10.2 | 75 | 54.9 | 51.1 | 135 | 98.7 | 92.1 | 195 | 142.6 | 133.0 | 255 | 186.5 | 173.9 |
| 16 | 11.7 | 10.9 | 76 | 55.6 | 51.8 | 136 | 99.5 | 92.8 | 196 | 143.3 | 133.7 | 256 | 187.2 | 174.6 |
| 17 | 12.4 | 11.6 | 77 | 56.3 | 52.5 | 137 | 100.2 | 93.4 | 197 | 144.1 | 134.4 | 257 | 188.0 | 175.3 |
| 18 | 13.2 | 12.3 | 78 | 57.0 | 53.2 | 138 | 100.9 | 94.1 | 198 | 144.8 | 135.0 | 258 | 188.7 | 176.0 |
| 19 | 13.9 | 13.0 | 79 | 57.8 | 53.9 | 139 | 101.7 | 94.8 | 199 | 145.5 | 135.7 | 259 | 189.4 | 176.6 |
| 20 | 14.6 | 13.6 | 80 | 58.5 | 54.6 | 140 | 102.4 | 95.5 | 200 | 146.3 | 136.4 | 260 | 190.2 | 177.3 |
| 21 | 15.4 | 14.3 | 81 | 59.2 | 55.2 | 141 | 103.1 | 96.2 | 201 | 147.0 | 137.1 | 261 | 190.9 | 178.0 |
| 22 | 16.1 | 15.0 | 82 | 60.0 | 55.9 | 142 | 103.9 | 96.8 | 202 | 147.7 | 137.8 | 262 | 191.6 | 178.7 |
| 23 | 16.8 | 15.7 | 83 | 60.7 | 56.6 | 143 | 104.6 | 97.5 | 203 | 148.5 | 138.4 | 263 | 192.3 | 179.4 |
| 24 | 17.6 | 16.4 | 84 | 61.4 | 57.3 | 144 | 105.3 | 98.2 | 204 | 149.2 | 139.1 | 264 | 193.1 | 180.0 |
| 25 | 18.3 | 17.0 | 85 | 62.2 | 58.0 | 145 | 106.0 | 98.9 | 205 | 149.9 | 139.8 | 265 | 193.8 | 180.7 |
| 26 | 19.0 | 17.7 | 86 | 62.9 | 58.7 | 146 | 106.8 | 99.6 | 206 | 150.7 | 140.5 | 266 | 194.5 | 181.4 |
| 27 | 19.7 | 18.4 | 87 | 63.6 | 59.3 | 147 | 107.5 | 100.3 | 207 | 151.4 | 141.2 | 267 | 195.3 | 182.1 |
| 28 | 20.5 | 19.1 | 88 | 64.4 | 60.0 | 148 | 108.2 | 100.9 | 208 | 152.1 | 141.9 | 268 | 196.0 | 182.8 |
| 29 | 21.2 | 19.8 | 89 | 65.1 | 60.7 | 149 | 109.0 | 101.6 | 209 | 152.9 | 142.5 | 269 | 196.7 | 183.5 |
| 30 | 21.9 | 20.5 | 90 | 65.8 | 61.4 | 150 | 109.7 | 102.3 | 210 | 153.6 | 143.2 | 270 | 197.5 | 184.1 |
| 31 | 22.7 | 21.1 | 91 | 66.6 | 62.1 | 151 | 110.4 | 103.0 | 211 | 154.3 | 143.9 | 271 | 198.2 | 184.8 |
| 32 | 23.4 | 21.8 | 92 | 67.3 | 62.7 | 152 | 111.2 | 103.7 | 212 | 155.0 | 144.6 | 272 | 198.9 | 185.5 |
| 33 | 24.1 | 22.5 | 93 | 68.0 | 63.4 | 153 | 111.9 | 104.3 | 213 | 155.8 | 145.3 | 273 | 199.7 | 186.2 |
| 34 | 24.9 | 23.2 | 94 | 68.7 | 64.1 | 154 | 112.6 | 105.0 | 214 | 156.5 | 145.9 | 274 | 200.4 | 186.9 |
| 35 | 25.6 | 23.9 | 95 | 69.5 | 64.8 | 155 | 113.4 | 105.7 | 215 | 157.2 | 146.6 | 275 | 201.1 | 187.5 |
| 36 | 26.3 | 24.6 | 96 | 70.2 | 65.5 | 156 | 114.1 | 106.4 | 216 | 158.0 | 147.3 | 276 | 201.9 | 188.2 |
| 37 | 27.1 | 25.2 | 97 | 70.9 | 66.2 | 157 | 114.8 | 107.1 | 217 | 158.7 | 148.0 | 277 | 202.6 | 188.9 |
| 38 | 27.8 | 25.9 | 98 | 71.7 | 66.8 | 158 | 115.6 | 107.8 | 218 | 159.4 | 148.7 | 278 | 203.3 | 189.6 |
| 39 | 28.5 | 26.6 | 99 | 72.4 | 67.5 | 159 | 116.3 | 108.4 | 219 | 160.2 | 149.4 | 279 | 204.0 | 190.3 |
| 40 | 29.3 | 27.3 | 100 | 73.1 | 68.2 | 160 | 117.0 | 109.1 | 220 | 160.9 | 150.0 | 280 | 204.8 | 191.0 |
| 41 | 30.0 | 28.0 | 101 | 73.9 | 68.9 | 161 | 117.7 | 109.8 | 221 | 161.6 | 150.7 | 281 | 205.5 | 191.6 |
| 42 | 30.7 | 28.6 | 102 | 74.6 | 69.6 | 162 | 118.5 | 110.5 | 222 | 162.4 | 151.4 | 282 | 206.2 | 192.3 |
| 43 | 31.4 | 29.3 | 103 | 75.3 | 70.2 | 163 | 119.2 | 111.2 | 223 | 163.1 | 152.1 | 283 | 207.0 | 193.0 |
| 44 | 32.2 | 30.0 | 104 | 76.1 | 70.9 | 164 | 119.9 | 111.8 | 224 | 163.8 | 152.8 | 284 | 207.7 | 193.7 |
| 45 | 32.9 | 30.7 | 105 | 76.8 | 71.6 | 165 | 120.7 | 112.5 | 225 | 164.6 | 153.4 | 285 | 208.4 | 194.4 |
| 46 | 33.6 | 31.4 | 106 | 77.5 | 72.3 | 166 | 121.4 | 113.2 | 226 | 165.3 | 154.1 | 286 | 209.2 | 195.1 |
| 47 | 34.4 | 32.1 | 107 | 78.3 | 73.0 | 167 | 122.1 | 113.9 | 227 | 166.0 | 154.8 | 287 | 209.9 | 195.7 |
| 48 | 35.1 | 32.7 | 108 | 79.0 | 73.7 | 168 | 122.9 | 114.6 | 228 | 166.7 | 155.5 | 288 | 210.6 | 196.4 |
| 49 | 35.8 | 33.4 | 109 | 79.7 | 74.3 | 169 | 123.6 | 115.3 | 229 | 167.5 | 156.2 | 289 | 211.4 | 197.1 |
| 50 | 36.6 | 34.1 | 110 | 80.4 | 75.0 | 170 | 124.3 | 115.9 | 230 | 168.2 | 156.9 | 290 | 212.1 | 197.8 |
| 51 | 37.3 | 34.8 | 111 | 81.2 | 75.7 | 171 | 125.1 | 116.6 | 231 | 168.9 | 157.5 | 291 | 212.8 | 198.5 |
| 52 | 38.0 | 35.5 | 112 | 81.9 | 76.4 | 172 | 125.8 | 117.3 | 232 | 169.7 | 158.2 | 292 | 213.6 | 199.1 |
| 53 | 38.8 | 36.1 | 113 | 82.6 | 77.1 | 173 | 126.5 | 118.0 | 233 | 170.4 | 158.9 | 293 | 214.3 | 199.8 |
| 54 | 39.5 | 36.8 | 114 | 83.4 | 77.7 | 174 | 127.3 | 118.7 | 234 | 171.1 | 159.6 | 294 | 215.0 | 200.5 |
| 55 | 40.2 | 37.5 | 115 | 84.1 | 78.4 | 175 | 128.0 | 119.3 | 235 | 171.9 | 160.3 | 295 | 215.7 | 201.2 |
| 56 | 41.0 | 38.2 | 116 | 84.8 | 79.1 | 176 | 128.7 | 120.0 | 236 | 172.6 | 161.0 | 296 | 216.5 | 201.9 |
| 57 | 41.7 | 38.9 | 117 | 85.6 | 79.8 | 177 | 129.4 | 120.7 | 237 | 173.3 | 161.6 | 297 | 217.2 | 202.6 |
| 58 | 42.4 | 39.6 | 118 | 86.3 | 80.5 | 178 | 130.2 | 121.4 | 238 | 174.1 | 162.3 | 298 | 217.9 | 203.2 |
| 59 | 43.1 | 40.2 | 119 | 87.0 | 81.2 | 179 | 130.9 | 122.1 | 239 | 174.8 | 163.0 | 299 | 218.7 | 203.9 |
| 60 | 43.9 | 40.9 | 120 | 87.8 | 81.8 | 180 | 131.6 | 122.8 | 240 | 175.5 | 163.7 | 300 | 219.4 | 204.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat | Dist. | Dep. | Lat. |

For 47 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 44 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.7 | 00.7 | 61 | 43.9 | 42.4 | 121 | 87.0 | 84.1 | 181 | 130.2 | 125.7 | 241 | 173.4 | 167.4 |
| 2 | 01.4 | 01.4 | 62 | 44.6 | 43.1 | 122 | 87.8 | 84.7 | 182 | 130.9 | 126.4 | 242 | 174.1 | 168.1 |
| 3 | 02.2 | 02.1 | 63 | 45.3 | 43.8 | 123 | 88.5 | 85.4 | 183 | 131.6 | 127.1 | 243 | 174.8 | 168.8 |
| 4 | 02.9 | 02.8 | 64 | 46.0 | 44.5 | 124 | 89.2 | 86.1 | 184 | 132.4 | 127.8 | 244 | 175.5 | 169.5 |
| 5 | 03.6 | 03.5 | 65 | 46.8 | 45.2 | 125 | 89.9 | 86.8 | 185 | 133.1 | 128.5 | 245 | 176.2 | 170.2 |
| 6 | 04.3 | 04.2 | 66 | 47.5 | 45.8 | 126 | 90.6 | 87.5 | 186 | 133.8 | 129.2 | 246 | 177.0 | 170.9 |
| 7 | 05.0 | 04.9 | 67 | 48.2 | 46.5 | 127 | 91.4 | 88.2 | 187 | 134.5 | 129.9 | 247 | 177.7 | 171.6 |
| 8 | 05.8 | 05.6 | 68 | 48.9 | 47.2 | 128 | 92.1 | 88.9 | 188 | 135.2 | 130.6 | 248 | 178.4 | 172.3 |
| 9 | 06.5 | 06.3 | 69 | 49.6 | 47.9 | 129 | 92.8 | 89.6 | 189 | 136.0 | 131.3 | 249 | 179.1 | 173.0 |
| 10 | 07.2 | 06.9 | 70 | 50.4 | 48.6 | 130 | 93.5 | 90.3 | 190 | 136.7 | 132.0 | 250 | 179.8 | 173.7 |
| 11 | 07.9 | 07.6 | 71 | 51.1 | 49.3 | 131 | 94.2 | 91.0 | 191 | 137.4 | 132.7 | 251 | 180.6 | 174.4 |
| 12 | 08.6 | 08.3 | 72 | 51.8 | 50.0 | 132 | 95.0 | 91.7 | 192 | 138.1 | 133.4 | 252 | 181.3 | 175.1 |
| 13 | 09.4 | 09.0 | 73 | 52.5 | 50.7 | 133 | 95.7 | 92.4 | 193 | 138.8 | 134.1 | 253 | 182.0 | 175.7 |
| 14 | 10.1 | 09.7 | 74 | 53.2 | 51.4 | 134 | 96.4 | 93.1 | 194 | 139.6 | 134.8 | 254 | 182.7 | 176.4 |
| 15 | 10.8 | 10.4 | 75 | 54.0 | 52.1 | 135 | 97.1 | 93.8 | 195 | 140.3 | 135.5 | 255 | 183.4 | 177.1 |
| 16 | 11.5 | 11.1 | 76 | 54.7 | 52.8 | 136 | 97.8 | 94.5 | 196 | 141.0 | 136.2 | 256 | 184.2 | 177.8 |
| 17 | 12.2 | 11.8 | 77 | 55.4 | 53.5 | 137 | 98.5 | 95.2 | 197 | 141.7 | 136.8 | 257 | 184.9 | 178.5 |
| 18 | 12.9 | 12.5 | 78 | 56.1 | 54.2 | 138 | 99.3 | 95.9 | 198 | 142.4 | 137.5 | 258 | 185.6 | 179.2 |
| 19 | 13.7 | 13.2 | 79 | 56.8 | 54.9 | 139 | 100.0 | 96.6 | 199 | 143.1 | 138.2 | 259 | 186.3 | 179.9 |
| 20 | 14.4 | 13.9 | 80 | 57.5 | 55.6 | 140 | 100.7 | 97.3 | 200 | 143.9 | 138.9 | 260 | 187.0 | 180.6 |
| 21 | 15.1 | 14.6 | 81 | 58.3 | 56.3 | 141 | 101.4 | 97.9 | 201 | 144.6 | 139.6 | 261 | 187.7 | 181.3 |
| 22 | 15.8 | 15.3 | 82 | 59.0 | 57.0 | 142 | 102.1 | 98.6 | 202 | 145.3 | 140.3 | 262 | 188.5 | 182.0 |
| 23 | 16.5 | 16.0 | 83 | 59.7 | 57.7 | 143 | 102.9 | 99.3 | 203 | 146.0 | 141.0 | 263 | 189.2 | 182.7 |
| 24 | 17.3 | 16.7 | 84 | 60.4 | 58.4 | 144 | 103.6 | 100.0 | 204 | 146.7 | 141.7 | 264 | 189.9 | 183.4 |
| 25 | 18.0 | 17.4 | 85 | 61.1 | 59.0 | 145 | 104.3 | 100.7 | 205 | 147.5 | 142.4 | 265 | 190.6 | 184.1 |
| 26 | 18.7 | 18.1 | 86 | 61.9 | 59.7 | 146 | 105.0 | 101.4 | 206 | 148.2 | 143.1 | 266 | 191.3 | 184.8 |
| 27 | 19.4 | 18.8 | 87 | 62.6 | 60.4 | 147 | 105.7 | 102.1 | 207 | 148.9 | 143.8 | 267 | 192.1 | 185.5 |
| 28 | 20.1 | 19.5 | 88 | 63.3 | 61.1 | 148 | 106.5 | 102.8 | 208 | 149.6 | 144.5 | 268 | 192.8 | 186.2 |
| 29 | 20.9 | 20.1 | 89 | 64.0 | 61.8 | 149 | 107.2 | 103.5 | 209 | 150.3 | 145.2 | 269 | 193.5 | 186.9 |
| 30 | 21.6 | 20.8 | 90 | 64.7 | 62.5 | 150 | 107.9 | 104.2 | 210 | 151.1 | 145.9 | 270 | 194.2 | 187.6 |
| 31 | 22.3 | 21.5 | 91 | 65.5 | 63.2 | 151 | 108.6 | 104.9 | 211 | 151.8 | 146.6 | 271 | 194.9 | 188.3 |
| 32 | 23.0 | 22.2 | 92 | 66.2 | 63.9 | 152 | 109.3 | 105.6 | 212 | 152.5 | 147.3 | 272 | 195.7 | 188.9 |
| 33 | 23.7 | 22.9 | 93 | 66.9 | 64.6 | 153 | 110.1 | 106.3 | 213 | 153.2 | 148.0 | 273 | 196.4 | 189.6 |
| 34 | 24.5 | 23.6 | 94 | 67.6 | 65.3 | 154 | 110.8 | 107.0 | 214 | 153.9 | 148.7 | 274 | 197.1 | 190.3 |
| 35 | 25.2 | 24.3 | 95 | 68.3 | 66.0 | 155 | 111.5 | 107.7 | 215 | 154.7 | 149.4 | 275 | 197.8 | 191.0 |
| 36 | 25.9 | 25.0 | 96 | 69.1 | 66.7 | 156 | 112.2 | 108.4 | 216 | 155.4 | 150.0 | 276 | 198.5 | 191.7 |
| 37 | 26.6 | 25.7 | 97 | 69.8 | 67.4 | 157 | 112.9 | 109.1 | 217 | 156.1 | 150.7 | 277 | 199.3 | 192.4 |
| 38 | 27.3 | 26.4 | 98 | 70.5 | 68.1 | 158 | 113.7 | 109.8 | 218 | 156.8 | 151.4 | 278 | 200.0 | 193.1 |
| 39 | 28.1 | 27.1 | 99 | 71.2 | 68.8 | 159 | 114.4 | 110.5 | 219 | 157.5 | 152.1 | 279 | 200.7 | 193.8 |
| 40 | 28.8 | 27.8 | 100 | 71.9 | 69.5 | 160 | 115.1 | 111.1 | 220 | 158.3 | 152.8 | 280 | 201.4 | 194.5 |
| 41 | 29.5 | 28.5 | 101 | 72.7 | 70.2 | 161 | 115.8 | 111.8 | 221 | 159.0 | 153.5 | 281 | 202.1 | 195.2 |
| 42 | 30.2 | 29.2 | 102 | 73.4 | 70.9 | 162 | 116.5 | 112.5 | 222 | 159.7 | 154.2 | 282 | 202.9 | 195.9 |
| 43 | 30.9 | 29.9 | 103 | 74.1 | 71.5 | 163 | 117.3 | 113.2 | 223 | 160.4 | 154.9 | 283 | 203.6 | 196.6 |
| 44 | 31.7 | 30.6 | 104 | 74.8 | 72.2 | 164 | 118.0 | 113.9 | 224 | 161.1 | 155.6 | 284 | 204.3 | 197.3 |
| 45 | 32.4 | 31.3 | 105 | 75.5 | 72.9 | 165 | 118.7 | 114.6 | 225 | 161.9 | 156.3 | 285 | 205.0 | 198.0 |
| 46 | 33.1 | 32.0 | 106 | 76.3 | 73.6 | 166 | 119.4 | 115.3 | 226 | 162.6 | 157.0 | 286 | 205.7 | 198.7 |
| 47 | 33.8 | 32.6 | 107 | 77.0 | 74.3 | 167 | 120.1 | 116.0 | 227 | 163.3 | 157.7 | 287 | 206.5 | 199.4 |
| 48 | 34.5 | 33.3 | 108 | 77.7 | 75.0 | 168 | 120.8 | 116.7 | 228 | 164.0 | 158.4 | 288 | 207.2 | 200.1 |
| 49 | 35.2 | 34.0 | 109 | 78.4 | 75.7 | 169 | 121.6 | 117.4 | 229 | 164.7 | 159.1 | 289 | 207.9 | 200.8 |
| 50 | 36.0 | 34.7 | 110 | 79.1 | 76.4 | 170 | 122.3 | 118.1 | 230 | 165.4 | 159.8 | 290 | 208.6 | 201.5 |
| 51 | 36.7 | 35.4 | 111 | 79.8 | 77.1 | 171 | 123.0 | 118.8 | 231 | 166.2 | 160.5 | 291 | 209.3 | 202.1 |
| 52 | 37.4 | 36.1 | 112 | 80.6 | 77.8 | 172 | 123.7 | 119.5 | 232 | 166.9 | 161.2 | 292 | 210.0 | 202.8 |
| 53 | 38.1 | 36.8 | 113 | 81.3 | 78.5 | 173 | 124.4 | 120.2 | 233 | 167.6 | 161.9 | 293 | 210.8 | 203.5 |
| 54 | 38.8 | 37.5 | 114 | 82.0 | 79.2 | 174 | 125.2 | 120.9 | 234 | 168.3 | 162.6 | 294 | 211.5 | 204.2 |
| 55 | 39.6 | 38.2 | 115 | 82.7 | 79.9 | 175 | 125.9 | 121.6 | 235 | 169.0 | 163.2 | 295 | 212.2 | 204.9 |
| 56 | 40.3 | 38.9 | 116 | 83.4 | 80.6 | 176 | 126.6 | 122.3 | 236 | 169.8 | 163.9 | 296 | 212.9 | 205.6 |
| 57 | 41.0 | 39.6 | 117 | 84.2 | 81.3 | 177 | 127.3 | 123.0 | 237 | 170.5 | 164.6 | 297 | 213.6 | 206.3 |
| 58 | 41.7 | 40.3 | 118 | 84.9 | 82.0 | 178 | 128.0 | 123.6 | 238 | 171.2 | 165.3 | 298 | 214.4 | 207.0 |
| 59 | 42.4 | 41.0 | 119 | 85.6 | 82.7 | 179 | 128.8 | 124.3 | 239 | 171.9 | 166.0 | 299 | 215.1 | 207.7 |
| 60 | 43.2 | 41.7 | 120 | 86.3 | 83.4 | 180 | 129.5 | 125.0 | 240 | 172.6 | 166.7 | 300 | 215.8 | 208.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

For 46 Degrees.

# TABLE II.

## Difference of Latitude and Departure for 45 Degrees.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00.7 | 00.7 | 61 | 43.1 | 43.1 | 121 | 85.6 | 85.6 | 181 | 128.0 | 128.0 | 241 | 170.4 | 170.4 |
| 2 | 01.4 | 01.4 | 62 | 43.8 | 43.8 | 122 | 86.3 | 86.3 | 182 | 128.7 | 128.7 | 242 | 171.1 | 171.1 |
| 3 | 02.1 | 02.1 | 63 | 44.5 | 44.5 | 123 | 87.0 | 87.0 | 183 | 129.4 | 129.4 | 243 | 171.8 | 171.8 |
| 4 | 02.8 | 02.8 | 64 | 45.3 | 45.3 | 124 | 87.7 | 87.7 | 184 | 130.1 | 130.1 | 244 | 172.5 | 172.5 |
| 5 | 03.5 | 03.5 | 65 | 46.0 | 46.0 | 125 | 88.4 | 88.4 | 185 | 130.8 | 130.8 | 245 | 173.2 | 173.2 |
| 6 | 04.2 | 04.2 | 66 | 46.7 | 46.7 | 126 | 89.1 | 89.1 | 186 | 131.5 | 131.5 | 246 | 173.9 | 173.9 |
| 7 | 04.9 | 04.9 | 67 | 47.4 | 47.4 | 127 | 89.8 | 89.8 | 187 | 132.2 | 132.2 | 247 | 174.7 | 174.7 |
| 8 | 05.7 | 05.7 | 68 | 48.1 | 48.1 | 128 | 90.5 | 90.5 | 188 | 132.9 | 132.9 | 248 | 175.4 | 175.4 |
| 9 | 06.4 | 06.4 | 69 | 48.8 | 48.8 | 129 | 91.2 | 91.2 | 189 | 133.6 | 133.6 | 249 | 176.1 | 176.1 |
| 10 | 07.1 | 07.1 | 70 | 49.5 | 49.5 | 130 | 91.9 | 91.9 | 190 | 134.3 | 134.3 | 250 | 176.8 | 176.8 |
| 11 | 07.8 | 07.8 | 71 | 50.2 | 50.2 | 131 | 92.6 | 92.6 | 191 | 135.1 | 135.1 | 251 | 177.5 | 177.5 |
| 12 | 08.5 | 08.5 | 72 | 50.9 | 50.9 | 132 | 93.3 | 93.3 | 192 | 135.8 | 135.8 | 252 | 178.2 | 178.2 |
| 13 | 09.2 | 09.2 | 73 | 51.6 | 51.6 | 133 | 94.0 | 94.0 | 193 | 136.5 | 136.5 | 253 | 178.9 | 178.9 |
| 14 | 09.9 | 09.9 | 74 | 52.3 | 52.3 | 134 | 94.8 | 94.8 | 194 | 137.2 | 137.2 | 254 | 179.6 | 179.6 |
| 15 | 10.6 | 10.6 | 75 | 53.0 | 53.0 | 135 | 95.5 | 95.5 | 195 | 137.9 | 137.9 | 255 | 180.3 | 180.3 |
| 16 | 11.3 | 11.3 | 76 | 53.7 | 53.7 | 136 | 96.2 | 96.2 | 196 | 138.6 | 138.6 | 256 | 181.0 | 181.0 |
| 17 | 12.0 | 12.0 | 77 | 54.4 | 54.4 | 137 | 96.9 | 96.9 | 197 | 139.3 | 139.3 | 257 | 181.7 | 181.7 |
| 18 | 12.7 | 12.7 | 78 | 55.2 | 55.2 | 138 | 97.6 | 97.6 | 198 | 140.0 | 140.0 | 258 | 182.4 | 182.4 |
| 19 | 13.4 | 13.4 | 79 | 55.9 | 55.9 | 139 | 98.3 | 98.3 | 199 | 140.7 | 140.7 | 259 | 183.1 | 183.1 |
| 20 | 14.1 | 14.1 | 80 | 56.6 | 56.6 | 140 | 99.0 | 99.0 | 200 | 141.4 | 141.4 | 260 | 183.8 | 183.8 |
| 21 | 14.8 | 14.8 | 81 | 57.3 | 57.3 | 141 | 99.7 | 99.7 | 201 | 142.1 | 142.1 | 261 | 184.6 | 184.6 |
| 22 | 15.6 | 15.6 | 82 | 58.0 | 58.0 | 142 | 100.4 | 100.4 | 202 | 142.8 | 142.8 | 262 | 185.3 | 185.3 |
| 23 | 16.3 | 16.3 | 83 | 58.7 | 58.7 | 143 | 101.1 | 101.1 | 203 | 143.5 | 143.5 | 263 | 186.0 | 186.0 |
| 24 | 17.0 | 17.0 | 84 | 59.4 | 59.4 | 144 | 101.8 | 101.8 | 204 | 144.2 | 144.2 | 264 | 186.7 | 186.7 |
| 25 | 17.7 | 17.7 | 85 | 60.1 | 60.1 | 145 | 102.5 | 102.5 | 205 | 145.0 | 145.0 | 265 | 187.4 | 187.4 |
| 26 | 18.4 | 18.4 | 86 | 60.8 | 60.8 | 146 | 103.2 | 103.2 | 206 | 145.7 | 145.7 | 266 | 188.1 | 188.1 |
| 27 | 19.1 | 19.1 | 87 | 61.5 | 61.5 | 147 | 103.9 | 103.9 | 207 | 146.4 | 146.4 | 267 | 188.8 | 188.8 |
| 28 | 19.8 | 19.8 | 88 | 62.2 | 62.2 | 148 | 104.7 | 104.7 | 208 | 147.1 | 147.1 | 268 | 189.5 | 189.5 |
| 29 | 20.5 | 20.5 | 89 | 62.9 | 62.9 | 149 | 105.4 | 105.4 | 209 | 147.8 | 147.8 | 269 | 190.2 | 190.2 |
| 30 | 21.2 | 21.2 | 90 | 63.6 | 63.6 | 150 | 106.1 | 106.1 | 210 | 148.5 | 148.5 | 270 | 190.9 | 190.9 |
| 31 | 21.9 | 21.9 | 91 | 64.3 | 64.3 | 151 | 106.8 | 106.8 | 211 | 149.2 | 149.2 | 271 | 191.6 | 191.6 |
| 32 | 22.6 | 22.6 | 92 | 65.1 | 65.1 | 152 | 107.5 | 107.5 | 212 | 149.9 | 149.9 | 272 | 192.3 | 192.3 |
| 33 | 23.3 | 23.3 | 93 | 65.8 | 65.8 | 153 | 108.2 | 108.2 | 213 | 150.6 | 150.6 | 273 | 193.0 | 193.0 |
| 34 | 24.0 | 24.0 | 94 | 66.5 | 66.5 | 154 | 108.9 | 108.9 | 214 | 151.3 | 151.3 | 274 | 193.7 | 193.7 |
| 35 | 24.7 | 24.7 | 95 | 67.2 | 67.2 | 155 | 109.6 | 109.6 | 215 | 152.0 | 152.0 | 275 | 194.5 | 194.5 |
| 36 | 25.5 | 25.5 | 96 | 67.9 | 67.9 | 156 | 110.3 | 110.3 | 216 | 152.7 | 152.7 | 276 | 195.2 | 195.2 |
| 37 | 26.2 | 26.2 | 97 | 68.6 | 68.6 | 157 | 111.0 | 111.0 | 217 | 153.4 | 153.4 | 277 | 195.9 | 195.9 |
| 38 | 26.9 | 26.9 | 98 | 69.3 | 69.3 | 158 | 111.7 | 111.7 | 218 | 154.1 | 154.1 | 278 | 196.6 | 196.6 |
| 39 | 27.6 | 27.6 | 99 | 70.0 | 70.0 | 159 | 112.4 | 112.4 | 219 | 154.9 | 154.9 | 279 | 197.3 | 197.3 |
| 40 | 28.3 | 28.3 | 100 | 70.7 | 70.7 | 160 | 113.1 | 113.1 | 220 | 155.6 | 155.6 | 280 | 198.0 | 198.0 |
| 41 | 29.0 | 29.0 | 101 | 71.4 | 71.4 | 161 | 113.8 | 113.8 | 221 | 156.3 | 156.3 | 281 | 198.7 | 198.7 |
| 42 | 29.7 | 29.7 | 102 | 72.1 | 72.1 | 162 | 114.5 | 114.5 | 222 | 157.0 | 157.0 | 282 | 199.4 | 199.4 |
| 43 | 30.4 | 30.4 | 103 | 72.8 | 72.8 | 163 | 115.3 | 115.3 | 223 | 157.7 | 157.7 | 283 | 200.1 | 200.1 |
| 44 | 31.1 | 31.1 | 104 | 73.5 | 73.5 | 164 | 116.0 | 116.0 | 224 | 158.4 | 158.4 | 284 | 200.8 | 200.8 |
| 45 | 31.8 | 31.8 | 105 | 74.2 | 74.2 | 165 | 116.7 | 116.7 | 225 | 159.1 | 159.1 | 285 | 201.5 | 201.5 |
| 46 | 32.5 | 32.5 | 106 | 75.0 | 75.0 | 166 | 117.4 | 117.4 | 226 | 159.8 | 159.8 | 286 | 202.2 | 202.2 |
| 47 | 33.2 | 33.2 | 107 | 75.7 | 75.7 | 167 | 118.1 | 118.1 | 227 | 160.5 | 160.5 | 287 | 202.9 | 202.9 |
| 48 | 33.9 | 33.9 | 108 | 76.4 | 76.4 | 168 | 118.8 | 118.8 | 228 | 161.2 | 161.2 | 288 | 203.6 | 203.6 |
| 49 | 34.6 | 34.6 | 109 | 77.1 | 77.1 | 169 | 119.5 | 119.5 | 229 | 161.9 | 161.9 | 289 | 204.3 | 204.3 |
| 50 | 35.4 | 35.4 | 110 | 77.8 | 77.8 | 170 | 120.2 | 120.2 | 230 | 162.6 | 162.6 | 290 | 205.1 | 205.1 |
| 51 | 36.1 | 36.1 | 111 | 78.5 | 78.5 | 171 | 120.9 | 120.9 | 231 | 163.3 | 163.3 | 291 | 205.8 | 205.8 |
| 52 | 36.8 | 36.8 | 112 | 79.2 | 79.2 | 172 | 121.6 | 121.6 | 232 | 164.0 | 164.0 | 292 | 206.5 | 206.5 |
| 53 | 37.5 | 37.5 | 113 | 79.9 | 79.9 | 173 | 122.3 | 122.3 | 233 | 164.8 | 164.8 | 293 | 207.2 | 207.2 |
| 54 | 38.2 | 38.2 | 114 | 80.6 | 80.6 | 174 | 123.0 | 123.0 | 234 | 165.5 | 165.5 | 294 | 207.9 | 207.9 |
| 55 | 38.9 | 38.9 | 115 | 81.3 | 81.3 | 175 | 123.7 | 123.7 | 235 | 166.2 | 166.2 | 295 | 208.6 | 208.6 |
| 56 | 39.6 | 39.6 | 116 | 82.0 | 82.0 | 176 | 124.4 | 124.4 | 236 | 166.9 | 166.9 | 296 | 209.3 | 209.3 |
| 57 | 40.3 | 40.3 | 117 | 82.7 | 82.7 | 177 | 125.2 | 125.2 | 237 | 167.6 | 167.6 | 297 | 210.0 | 210.0 |
| 58 | 41.0 | 41.0 | 118 | 83.4 | 83.4 | 178 | 125.9 | 125.9 | 238 | 168.3 | 168.3 | 298 | 210.7 | 210.7 |
| 59 | 41.7 | 41.7 | 119 | 84.1 | 84.1 | 179 | 126.6 | 126.6 | 239 | 169.0 | 169.0 | 299 | 211.4 | 211.4 |
| 60 | 42.4 | 42.4 | 120 | 84.9 | 84.9 | 180 | 127.3 | 127.3 | 240 | 169.7 | 169.7 | 300 | 212.1 | 212.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

# TABLE III.

## MERIDIONAL PARTS.

| M | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° | 11° | 12° | 13° | 14° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 60 | 120 | 180 | 240 | 300 | 361 | 421 | 482 | 542 | 603 | 664 | 725 | 787 | 849 | 0 |
| 1 | 1 | 61 | 121 | 181 | 241 | 301 | 362 | 422 | 483 | 543 | 604 | 665 | 726 | 788 | 850 | 1 |
| 2 | 2 | 62 | 122 | 182 | 242 | 302 | 363 | 423 | 484 | 544 | 605 | 666 | 727 | 789 | 851 | 2 |
| 3 | 3 | 63 | 123 | 183 | 243 | 303 | 364 | 424 | 485 | 545 | 606 | 667 | 728 | 790 | 852 | 3 |
| 4 | 4 | 64 | 124 | 184 | 244 | 304 | 365 | 425 | 486 | 546 | 607 | 668 | 729 | 791 | 853 | 4 |
| 5 | 5 | 65 | 125 | 185 | 245 | 305 | 366 | 426 | 487 | 547 | 608 | 669 | 730 | 792 | 854 | 5 |
| 6 | 6 | 66 | 126 | 186 | 246 | 306 | 367 | 427 | 488 | 548 | 609 | 670 | 731 | 793 | 855 | 6 |
| 7 | 7 | 67 | 127 | 187 | 247 | 307 | 368 | 428 | 489 | 549 | 610 | 671 | 732 | 794 | 856 | 7 |
| 8 | 8 | 68 | 128 | 188 | 248 | 308 | 369 | 429 | 490 | 550 | 611 | 672 | 734 | 795 | 857 | 8 |
| 9 | 9 | 69 | 129 | 189 | 249 | 309 | 370 | 430 | 491 | 551 | 612 | 673 | 735 | 796 | 858 | 9 |
| 10 | 10 | 70 | 130 | 190 | 250 | 310 | 371 | 431 | 492 | 552 | 613 | 674 | 736 | 797 | 859 | 10 |
| 11 | 11 | 71 | 131 | 191 | 251 | 311 | 372 | 432 | 493 | 553 | 614 | 675 | 737 | 798 | 860 | 11 |
| 12 | 12 | 72 | 132 | 192 | 252 | 312 | 373 | 433 | 494 | 554 | 615 | 676 | 738 | 799 | 861 | 12 |
| 13 | 13 | 73 | 133 | 193 | 253 | 313 | 374 | 434 | 495 | 555 | 616 | 677 | 739 | 800 | 862 | 13 |
| 14 | 14 | 74 | 134 | 194 | 254 | 314 | 375 | 435 | 496 | 556 | 617 | 678 | 740 | 801 | 863 | 14 |
| 15 | 15 | 75 | 135 | 195 | 255 | 315 | 376 | 436 | 497 | 557 | 618 | 679 | 741 | 802 | 864 | 15 |
| 16 | 16 | 76 | 136 | 196 | 256 | 316 | 377 | 437 | 498 | 558 | 619 | 680 | 742 | 803 | 865 | 16 |
| 17 | 17 | 77 | 137 | 197 | 257 | 317 | 378 | 438 | 499 | 559 | 620 | 681 | 743 | 804 | 866 | 17 |
| 18 | 18 | 78 | 138 | 198 | 258 | 318 | 379 | 439 | 500 | 560 | 621 | 682 | 744 | 805 | 867 | 18 |
| 19 | 19 | 79 | 139 | 199 | 259 | 319 | 380 | 440 | 501 | 561 | 622 | 683 | 745 | 806 | 868 | 19 |
| 20 | 20 | 80 | 140 | 200 | 260 | 320 | 381 | 441 | 502 | 562 | 623 | 684 | 746 | 807 | 869 | 20 |
| 21 | 21 | 81 | 141 | 201 | 261 | 321 | 382 | 442 | 503 | 564 | 624 | 685 | 747 | 808 | 870 | 21 |
| 22 | 22 | 82 | 142 | 202 | 262 | 322 | 383 | 443 | 504 | 565 | 625 | 687 | 748 | 809 | 871 | 22 |
| 23 | 23 | 83 | 143 | 203 | 263 | 323 | 384 | 444 | 505 | 566 | 626 | 688 | 749 | 810 | 872 | 23 |
| 24 | 24 | 84 | 144 | 204 | 264 | 324 | 385 | 445 | 506 | 567 | 627 | 689 | 750 | 811 | 873 | 24 |
| 25 | 25 | 85 | 145 | 205 | 265 | 325 | 386 | 446 | 507 | 568 | 628 | 690 | 751 | 812 | 874 | 25 |
| 26 | 26 | 86 | 146 | 206 | 266 | 326 | 387 | 447 | 508 | 569 | 629 | 691 | 752 | 813 | 875 | 26 |
| 27 | 27 | 87 | 147 | 207 | 267 | 327 | 388 | 448 | 509 | 570 | 631 | 692 | 753 | 815 | 876 | 27 |
| 28 | 28 | 88 | 148 | 208 | 268 | 328 | 389 | 449 | 510 | 571 | 632 | 693 | 754 | 816 | 877 | 28 |
| 29 | 29 | 89 | 149 | 209 | 269 | 330 | 390 | 450 | 511 | 572 | 633 | 694 | 755 | 817 | 878 | 29 |
| 30 | 30 | 90 | 150 | 210 | 270 | 331 | 391 | 451 | 512 | 573 | 634 | 695 | 756 | 818 | 879 | 30 |
| 31 | 31 | 91 | 151 | 211 | 271 | 332 | 392 | 452 | 513 | 574 | 635 | 696 | 757 | 819 | 880 | 31 |
| 32 | 32 | 92 | 152 | 212 | 272 | 333 | 393 | 453 | 514 | 575 | 636 | 697 | 758 | 820 | 882 | 32 |
| 33 | 33 | 93 | 153 | 213 | 273 | 334 | 394 | 454 | 515 | 576 | 637 | 698 | 759 | 821 | 883 | 33 |
| 34 | 34 | 94 | 154 | 214 | 274 | 335 | 395 | 455 | 516 | 577 | 638 | 699 | 760 | 822 | 884 | 34 |
| 35 | 35 | 95 | 155 | 215 | 275 | 336 | 396 | 456 | 517 | 578 | 639 | 700 | 761 | 823 | 885 | 35 |
| 36 | 36 | 96 | 156 | 216 | 276 | 337 | 397 | 457 | 518 | 579 | 640 | 701 | 762 | 824 | 886 | 36 |
| 37 | 37 | 97 | 157 | 217 | 277 | 338 | 398 | 458 | 519 | 580 | 641 | 702 | 763 | 825 | 887 | 37 |
| 38 | 38 | 98 | 158 | 218 | 278 | 339 | 399 | 459 | 520 | 581 | 642 | 703 | 764 | 826 | 888 | 38 |
| 39 | 39 | 99 | 159 | 219 | 279 | 340 | 400 | 460 | 521 | 582 | 643 | 704 | 765 | 827 | 889 | 39 |
| 40 | 40 | 100 | 160 | 220 | 280 | 341 | 401 | 461 | 522 | 583 | 644 | 705 | 766 | 828 | 890 | 40 |
| 41 | 41 | 101 | 161 | 221 | 281 | 342 | 402 | 462 | 523 | 584 | 645 | 706 | 767 | 829 | 891 | 41 |
| 42 | 42 | 102 | 162 | 222 | 282 | 343 | 403 | 463 | 524 | 585 | 646 | 707 | 768 | 830 | 892 | 42 |
| 43 | 43 | 103 | 163 | 223 | 283 | 344 | 404 | 464 | 525 | 586 | 647 | 708 | 769 | 831 | 893 | 43 |
| 44 | 44 | 104 | 164 | 224 | 284 | 345 | 405 | 465 | 526 | 587 | 648 | 709 | 770 | 832 | 894 | 44 |
| 45 | 45 | 105 | 165 | 225 | 285 | 346 | 406 | 466 | 527 | 588 | 649 | 710 | 771 | 833 | 895 | 45 |
| 46 | 46 | 106 | 166 | 226 | 286 | 347 | 407 | 467 | 528 | 589 | 650 | 711 | 772 | 834 | 896 | 46 |
| 47 | 47 | 107 | 167 | 227 | 287 | 348 | 408 | 468 | 529 | 590 | 651 | 712 | 773 | 835 | 897 | 47 |
| 48 | 48 | 108 | 168 | 228 | 288 | 349 | 409 | 469 | 530 | 591 | 652 | 713 | 774 | 836 | 898 | 48 |
| 49 | 49 | 109 | 169 | 229 | 289 | 350 | 410 | 470 | 531 | 592 | 653 | 714 | 776 | 837 | 899 | 49 |
| 50 | 50 | 110 | 170 | 230 | 290 | 351 | 411 | 471 | 532 | 593 | 654 | 715 | 777 | 838 | 900 | 50 |
| 51 | 51 | 111 | 171 | 231 | 291 | 352 | 412 | 472 | 533 | 594 | 655 | 716 | 778 | 839 | 901 | 51 |
| 52 | 52 | 112 | 172 | 232 | 292 | 353 | 413 | 473 | 534 | 595 | 656 | 717 | 779 | 840 | 902 | 52 |
| 53 | 53 | 113 | 173 | 233 | 293 | 354 | 414 | 474 | 535 | 596 | 657 | 718 | 780 | 841 | 903 | 53 |
| 54 | 54 | 114 | 174 | 234 | 294 | 355 | 415 | 476 | 536 | 597 | 658 | 719 | 781 | 842 | 904 | 54 |
| 55 | 55 | 115 | 175 | 235 | 295 | 356 | 416 | 477 | 537 | 598 | 659 | 720 | 782 | 843 | 905 | 55 |
| 56 | 56 | 116 | 176 | 236 | 296 | 357 | 417 | 478 | 538 | 599 | 660 | 721 | 783 | 844 | 906 | 56 |
| 57 | 57 | 117 | 177 | 237 | 297 | 358 | 418 | 479 | 539 | 600 | 661 | 722 | 784 | 845 | 907 | 57 |
| 58 | 58 | 118 | 178 | 238 | 298 | 359 | 419 | 480 | 540 | 601 | 662 | 723 | 785 | 846 | 908 | 58 |
| 59 | 59 | 119 | 179 | 239 | 299 | 360 | 420 | 481 | 541 | 602 | 663 | 724 | 786 | 847 | 909 | 59 |
| M | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° | 11° | 12° | 13° | 14° | M |

# TABLE III.

## MERIDIONAL PARTS.

| M | 15° | 16° | 17° | 18° | 19° | 20° | 21° | 22° | 23° | 24° | 25° | 26° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 910 | 973 | 1035 | 1098 | 1161 | 1225 | 1289 | 1354 | 1419 | 1484 | 1550 | 1616 | 0 |
| 1 | 912 | 974 | 1036 | 1099 | 1163 | 1226 | 1290 | 1355 | 1420 | 1485 | 1551 | 1618 | 1 |
| 2 | 913 | 975 | 1037 | 1100 | 1164 | 1227 | 1291 | 1356 | 1421 | 1486 | 1552 | 1619 | 2 |
| 3 | 914 | 976 | 1038 | 1101 | 1165 | 1228 | 1292 | 1357 | 1422 | 1487 | 1553 | 1620 | 3 |
| 4 | 915 | 977 | 1039 | 1102 | 1166 | 1229 | 1293 | 1358 | 1423 | 1488 | 1554 | 1621 | 4 |
| 5 | 916 | 978 | 1041 | 1103 | 1167 | 1230 | 1295 | 1359 | 1424 | 1490 | 1556 | 1622 | 5 |
| 6 | 917 | 979 | 1042 | 1105 | 1168 | 1232 | 1296 | 1360 | 1425 | 1491 | 1557 | 1623 | 6 |
| 7 | 918 | 980 | 1043 | 1106 | 1169 | 1233 | 1297 | 1361 | 1426 | 1492 | 1558 | 1624 | 7 |
| 8 | 919 | 981 | 1044 | 1107 | 1170 | 1234 | 1298 | 1362 | 1427 | 1493 | 1559 | 1625 | 8 |
| 9 | 920 | 982 | 1045 | 1108 | 1171 | 1235 | 1299 | 1363 | 1428 | 1494 | 1560 | 1626 | 9 |
| 10 | 921 | 983 | 1046 | 1109 | 1172 | 1236 | 1300 | 1364 | 1430 | 1495 | 1561 | 1628 | 10 |
| 11 | 922 | 984 | 1047 | 1110 | 1173 | 1237 | 1301 | 1366 | 1431 | 1496 | 1562 | 1629 | 11 |
| 12 | 923 | 985 | 1048 | 1111 | 1174 | 1238 | 1302 | 1367 | 1432 | 1497 | 1563 | 1630 | 12 |
| 13 | 924 | 986 | 1049 | 1112 | 1175 | 1239 | 1303 | 1368 | 1433 | 1498 | 1564 | 1631 | 13 |
| 14 | 925 | 987 | 1050 | 1113 | 1176 | 1240 | 1304 | 1369 | 1434 | 1499 | 1565 | 1632 | 14 |
| 15 | 926 | 988 | 1051 | 1114 | 1177 | 1241 | 1305 | 1370 | 1435 | 1500 | 1567 | 1633 | 15 |
| 16 | 927 | 989 | 1052 | 1115 | 1178 | 1242 | 1306 | 1371 | 1436 | 1502 | 1568 | 1634 | 16 |
| 17 | 928 | 990 | 1053 | 1116 | 1179 | 1243 | 1307 | 1372 | 1437 | 1503 | 1569 | 1635 | 17 |
| 18 | 929 | 991 | 1054 | 1117 | 1181 | 1244 | 1308 | 1373 | 1438 | 1504 | 1570 | 1637 | 18 |
| 19 | 930 | 993 | 1055 | 1118 | 1182 | 1245 | 1310 | 1374 | 1439 | 1505 | 1571 | 1638 | 19 |
| 20 | 931 | 994 | 1056 | 1119 | 1183 | 1246 | 1311 | 1375 | 1440 | 1506 | 1572 | 1639 | 20 |
| 21 | 932 | 995 | 1057 | 1120 | 1184 | 1248 | 1312 | 1376 | 1441 | 1507 | 1573 | 1640 | 21 |
| 22 | 933 | 996 | 1058 | 1121 | 1185 | 1249 | 1313 | 1377 | 1443 | 1508 | 1574 | 1641 | 22 |
| 23 | 934 | 997 | 1059 | 1122 | 1186 | 1250 | 1314 | 1379 | 1444 | 1509 | 1575 | 1642 | 23 |
| 24 | 935 | 998 | 1060 | 1123 | 1187 | 1251 | 1315 | 1380 | 1445 | 1510 | 1577 | 1643 | 24 |
| 25 | 936 | 999 | 1061 | 1125 | 1188 | 1252 | 1316 | 1381 | 1446 | 1511 | 1578 | 1644 | 25 |
| 26 | 937 | 1000 | 1063 | 1126 | 1189 | 1253 | 1317 | 1382 | 1447 | 1513 | 1579 | 1645 | 26 |
| 27 | 938 | 1001 | 1064 | 1127 | 1190 | 1254 | 1318 | 1383 | 1448 | 1514 | 1580 | 1647 | 27 |
| 28 | 939 | 1002 | 1065 | 1128 | 1191 | 1255 | 1319 | 1384 | 1449 | 1515 | 1581 | 1648 | 28 |
| 29 | 941 | 1003 | 1066 | 1129 | 1192 | 1256 | 1320 | 1385 | 1450 | 1516 | 1582 | 1649 | 29 |
| 30 | 942 | 1004 | 1067 | 1130 | 1193 | 1257 | 1321 | 1386 | 1451 | 1517 | 1583 | 1650 | 30 |
| 31 | 943 | 1005 | 1068 | 1131 | 1194 | 1258 | 1322 | 1387 | 1452 | 1518 | 1584 | 1651 | 31 |
| 32 | 944 | 1006 | 1069 | 1132 | 1195 | 1259 | 1324 | 1388 | 1453 | 1519 | 1585 | 1652 | 32 |
| 33 | 945 | 1007 | 1070 | 1133 | 1196 | 1260 | 1325 | 1389 | 1455 | 1520 | 1586 | 1653 | 33 |
| 34 | 946 | 1008 | 1071 | 1134 | 1198 | 1261 | 1326 | 1390 | 1456 | 1521 | 1588 | 1654 | 34 |
| 35 | 947 | 1009 | 1072 | 1135 | 1199 | 1262 | 1327 | 1392 | 1457 | 1522 | 1589 | 1656 | 35 |
| 36 | 948 | 1010 | 1073 | 1136 | 1200 | 1264 | 1328 | 1393 | 1458 | 1524 | 1590 | 1657 | 36 |
| 37 | 949 | 1011 | 1074 | 1137 | 1201 | 1265 | 1329 | 1394 | 1459 | 1525 | 1591 | 1658 | 37 |
| 38 | 950 | 1012 | 1075 | 1138 | 1202 | 1266 | 1330 | 1395 | 1460 | 1526 | 1592 | 1659 | 38 |
| 39 | 951 | 1013 | 1076 | 1139 | 1203 | 1267 | 1331 | 1396 | 1461 | 1527 | 1593 | 1660 | 39 |
| 40 | 952 | 1014 | 1077 | 1140 | 1204 | 1268 | 1332 | 1397 | 1462 | 1528 | 1594 | 1661 | 40 |
| 41 | 953 | 1015 | 1078 | 1141 | 1205 | 1269 | 1333 | 1398 | 1463 | 1529 | 1595 | 1662 | 41 |
| 42 | 954 | 1016 | 1079 | 1142 | 1206 | 1270 | 1334 | 1399 | 1464 | 1530 | 1596 | 1663 | 42 |
| 43 | 955 | 1018 | 1080 | 1144 | 1207 | 1271 | 1335 | 1400 | 1465 | 1531 | 1598 | 1664 | 43 |
| 44 | 956 | 1019 | 1081 | 1145 | 1208 | 1272 | 1336 | 1401 | 1467 | 1532 | 1599 | 1666 | 44 |
| 45 | 957 | 1020 | 1082 | 1146 | 1209 | 1273 | 1338 | 1402 | 1468 | 1533 | 1600 | 1667 | 45 |
| 46 | 958 | 1021 | 1084 | 1147 | 1210 | 1274 | 1339 | 1403 | 1469 | 1535 | 1601 | 1668 | 46 |
| 47 | 959 | 1022 | 1085 | 1148 | 1211 | 1275 | 1340 | 1405 | 1470 | 1536 | 1602 | 1669 | 47 |
| 48 | 960 | 1023 | 1086 | 1149 | 1212 | 1276 | 1341 | 1406 | 1471 | 1537 | 1603 | 1670 | 48 |
| 49 | 961 | 1024 | 1087 | 1150 | 1213 | 1277 | 1342 | 1407 | 1472 | 1538 | 1604 | 1671 | 49 |
| 50 | 962 | 1025 | 1088 | 1151 | 1215 | 1278 | 1343 | 1408 | 1473 | 1539 | 1605 | 1672 | 50 |
| 51 | 963 | 1026 | 1089 | 1152 | 1216 | 1280 | 1344 | 1409 | 1474 | 1540 | 1606 | 1673 | 51 |
| 52 | 964 | 1027 | 1090 | 1153 | 1217 | 1281 | 1345 | 1410 | 1475 | 1541 | 1608 | 1675 | 52 |
| 53 | 965 | 1028 | 1091 | 1154 | 1218 | 1282 | 1346 | 1411 | 1476 | 1542 | 1609 | 1676 | 53 |
| 54 | 966 | 1029 | 1092 | 1155 | 1219 | 1283 | 1347 | 1412 | 1477 | 1543 | 1610 | 1677 | 54 |
| 55 | 968 | 1030 | 1093 | 1156 | 1220 | 1284 | 1348 | 1413 | 1479 | 1544 | 1611 | 1678 | 55 |
| 56 | 969 | 1031 | 1094 | 1157 | 1221 | 1285 | 1349 | 1414 | 1480 | 1546 | 1612 | 1679 | 56 |
| 57 | 970 | 1032 | 1095 | 1158 | 1222 | 1286 | 1350 | 1415 | 1481 | 1547 | 1613 | 1680 | 57 |
| 58 | 971 | 1033 | 1096 | 1159 | 1223 | 1287 | 1352 | 1416 | 1482 | 1548 | 1614 | 1681 | 58 |
| 59 | 972 | 1034 | 1097 | 1160 | 1224 | 1288 | 1353 | 1418 | 1483 | 1549 | 1615 | 1682 | 59 |
| M | 15° | 16° | 17° | 18° | 19° | 20° | 21° | 22° | 23° | 24° | 25° | 26° | M |

# TABLE III.

## MERIDIONAL PARTS.

| M | 27° | 28° | 29° | 30° | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1684 | 1751 | 1819 | 1888 | 1958 | 2028 | 2100 | 2171 | 2244 | 2318 | 2393 | 2468 | 0 |
| 1 | 1685 | 1752 | 1821 | 1890 | 1959 | 2030 | 2101 | 2173 | 2246 | 2319 | 2394 | 2470 | 1 |
| 2 | 1686 | 1753 | 1822 | 1891 | 1960 | 2031 | 2102 | 2174 | 2247 | 2320 | 2395 | 2471 | 2 |
| 3 | 1687 | 1755 | 1823 | 1892 | 1962 | 2032 | 2103 | 2175 | 2248 | 2322 | 2396 | 2472 | 3 |
| 4 | 1688 | 1756 | 1824 | 1893 | 1963 | 2033 | 2104 | 2176 | 2249 | 2323 | 2398 | 2473 | 4 |
| 5 | 1689 | 1757 | 1825 | 1894 | 1964 | 2034 | 2105 | 2178 | 2250 | 2324 | 2399 | 2475 | 5 |
| 6 | 1690 | 1758 | 1826 | 1895 | 1965 | 2035 | 2107 | 2179 | 2252 | 2325 | 2400 | 2476 | 6 |
| 7 | 1691 | 1759 | 1827 | 1896 | 1966 | 2037 | 2108 | 2180 | 2253 | 2327 | 2401 | 2477 | 7 |
| 8 | 1693 | 1760 | 1829 | 1898 | 1967 | 2038 | 2109 | 2181 | 2234 | 2328 | 2403 | 2478 | 8 |
| 9 | 1694 | 1761 | 1830 | 1899 | 1969 | 2039 | 2110 | 2182 | 2255 | 2329 | 2404 | 2480 | 9 |
| 10 | 1695 | 1762 | 1831 | 1900 | 1970 | 2040 | 2111 | 2184 | 2257 | 2330 | 2405 | 2481 | 10 |
| 11 | 1696 | 1764 | 1832 | 1901 | 1971 | 2041 | 2113 | 2185 | 2258 | 2332 | 2406 | 2482 | 11 |
| 12 | 1697 | 1765 | 1833 | 1902 | 1972 | 2043 | 2114 | 2186 | 2259 | 2333 | 2408 | 2484 | 12 |
| 13 | 1698 | 1766 | 1834 | 1903 | 1973 | 2044 | 2115 | 2187 | 2260 | 2334 | 2409 | 2485 | 13 |
| 14 | 1699 | 1767 | 1835 | 1905 | 1974 | 2045 | 2116 | 2188 | 2261 | 2335 | 2410 | 2486 | 14 |
| 15 | 1700 | 1768 | 1837 | 1906 | 1976 | 2046 | 2117 | 2190 | 2263 | 2337 | 2411 | 2487 | 15 |
| 16 | 1701 | 1769 | 1838 | 1907 | 1977 | 2047 | 2119 | 2191 | 2264 | 2338 | 2413 | 2489 | 16 |
| 17 | 1703 | 1770 | 1839 | 1908 | 1978 | 2048 | 2120 | 2192 | 2265 | 2339 | 2414 | 2490 | 17 |
| 18 | 1704 | 1772 | 1840 | 1909 | 1979 | 2050 | 2121 | 2193 | 2266 | 2340 | 2415 | 2491 | 18 |
| 19 | 1705 | 1773 | 1841 | 1910 | 1980 | 2051 | 2122 | 2194 | 2268 | 2342 | 2416 | 2492 | 19 |
| 20 | 1706 | 1774 | 1842 | 1912 | 1981 | 2052 | 2123 | 2196 | 2269 | 2343 | 2418 | 2494 | 20 |
| 21 | 1707 | 1775 | 1843 | 1913 | 1983 | 2053 | 2125 | 2197 | 2270 | 2344 | 2419 | 2495 | 21 |
| 22 | 1708 | 1776 | 1845 | 1914 | 1984 | 2054 | 2126 | 2198 | 2271 | 2345 | 2420 | 2496 | 22 |
| 23 | 1709 | 1777 | 1846 | 1915 | 1985 | 2056 | 2127 | 2199 | 2272 | 2346 | 2422 | 2498 | 23 |
| 24 | 1711 | 1778 | 1847 | 1916 | 1986 | 2057 | 2128 | 2200 | 2274 | 2348 | 2423 | 2499 | 24 |
| 25 | 1712 | 1780 | 1848 | 1917 | 1987 | 2058 | 2129 | 2202 | 2275 | 2349 | 2424 | 2500 | 25 |
| 26 | 1713 | 1781 | 1849 | 1918 | 1988 | 2059 | 2131 | 2203 | 2276 | 2350 | 2425 | 2501 | 26 |
| 27 | 1714 | 1782 | 1850 | 1920 | 1990 | 2060 | 2132 | 2204 | 2277 | 2351 | 2427 | 2503 | 27 |
| 28 | 1715 | 1783 | 1852 | 1921 | 1991 | 2061 | 2133 | 2205 | 2279 | 2353 | 2428 | 2504 | 28 |
| 29 | 1716 | 1784 | 1853 | 1922 | 1992 | 2063 | 2134 | 2207 | 2280 | 2354 | 2429 | 2505 | 29 |
| 30 | 1717 | 1785 | 1854 | 1923 | 1993 | 2064 | 2135 | 2208 | 2281 | 2355 | 2430 | 2506 | 30 |
| 31 | 1718 | 1786 | 1855 | 1924 | 1994 | 2065 | 2137 | 2209 | 2282 | 2356 | 2432 | 2508 | 31 |
| 32 | 1720 | 1787 | 1856 | 1925 | 1995 | 2066 | 2138 | 2210 | 2283 | 2358 | 2433 | 2509 | 32 |
| 33 | 1721 | 1789 | 1857 | 1927 | 1997 | 2067 | 2139 | 2211 | 2285 | 2359 | 2434 | 2510 | 33 |
| 34 | 1722 | 1790 | 1858 | 1928 | 1998 | 2069 | 2140 | 2213 | 2286 | 2360 | 2435 | 2512 | 34 |
| 35 | 1723 | 1791 | 1860 | 1929 | 1999 | 2070 | 2141 | 2214 | 2287 | 2361 | 2437 | 2513 | 35 |
| 36 | 1724 | 1792 | 1861 | 1930 | 2000 | 2071 | 2143 | 2215 | 2288 | 2363 | 2438 | 2514 | 36 |
| 37 | 1725 | 1793 | 1862 | 1931 | 2001 | 2072 | 2144 | 2216 | 2290 | 2364 | 2439 | 2515 | 37 |
| 38 | 1726 | 1794 | 1863 | 1932 | 2002 | 2073 | 2145 | 2217 | 2291 | 2365 | 2440 | 2517 | 38 |
| 39 | 1727 | 1795 | 1864 | 1934 | 2004 | 2075 | 2146 | 2219 | 2292 | 2366 | 2442 | 2518 | 39 |
| 40 | 1729 | 1797 | 1865 | 1935 | 2005 | 2076 | 2147 | 2220 | 2293 | 2368 | 2443 | 2519 | 40 |
| 41 | 1730 | 1798 | 1866 | 1936 | 2006 | 2077 | 2149 | 2221 | 2295 | 2369 | 2444 | 2521 | 41 |
| 42 | 1731 | 1799 | 1868 | 1937 | 2007 | 2078 | 2150 | 2222 | 2296 | 2370 | 2445 | 2522 | 42 |
| 43 | 1732 | 1800 | 1869 | 1938 | 2008 | 2079 | 2151 | 2224 | 2297 | 2371 | 2447 | 2523 | 43 |
| 44 | 1733 | 1801 | 1870 | 1939 | 2010 | 2080 | 2152 | 2225 | 2298 | 2373 | 2448 | 2524 | 44 |
| 45 | 1734 | 1802 | 1871 | 1941 | 2011 | 2082 | 2153 | 2226 | 2299 | 2374 | 2449 | 2526 | 45 |
| 46 | 1735 | 1803 | 1872 | 1942 | 2012 | 2083 | 2155 | 2227 | 2301 | 2375 | 2451 | 2527 | 46 |
| 47 | 1736 | 1805 | 1873 | 1943 | 2013 | 2084 | 2156 | 2228 | 2302 | 2376 | 2452 | 2528 | 47 |
| 48 | 1738 | 1806 | 1875 | 1944 | 2014 | 2085 | 2157 | 2230 | 2303 | 2378 | 2453 | 2530 | 48 |
| 49 | 1739 | 1807 | 1876 | 1945 | 2015 | 2086 | 2158 | 2231 | 2304 | 2379 | 2454 | 2531 | 49 |
| 50 | 1740 | 1808 | 1877 | 1946 | 2017 | 2088 | 2159 | 2232 | 2306 | 2380 | 2456 | 2532 | 50 |
| 51 | 1741 | 1809 | 1878 | 1948 | 2018 | 2089 | 2161 | 2233 | 2307 | 2381 | 2457 | 2533 | 51 |
| 52 | 1742 | 1810 | 1879 | 1949 | 2019 | 2090 | 2162 | 2235 | 2308 | 2383 | 2458 | 2535 | 52 |
| 53 | 1743 | 1811 | 1880 | 1950 | 2020 | 2091 | 2163 | 2236 | 2309 | 2384 | 2459 | 2536 | 53 |
| 54 | 1744 | 1813 | 1881 | 1951 | 2021 | 2092 | 2164 | 2237 | 2311 | 2385 | 2461 | 2537 | 54 |
| 55 | 1746 | 1814 | 1883 | 1952 | 2022 | 2094 | 2165 | 2238 | 2312 | 2386 | 2462 | 2538 | 55 |
| 56 | 1747 | 1815 | 1884 | 1953 | 2024 | 2095 | 2167 | 2239 | 2313 | 2388 | 2463 | 2540 | 56 |
| 57 | 1748 | 1816 | 1885 | 1955 | 2025 | 2096 | 2168 | 2241 | 2314 | 2389 | 2464 | 2541 | 57 |
| 58 | 1749 | 1817 | 1886 | 1956 | 2026 | 2097 | 2169 | 2242 | 2316 | 2390 | 2466 | 2542 | 58 |
| 59 | 1750 | 1818 | 1887 | 1957 | 2027 | 2098 | 2170 | 2243 | 2317 | 2391 | 2467 | 2544 | 59 |
| M | 27° | 28° | 29° | 30° | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | M |

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MERIDIONAL PARTS.

| M | 39° | 40° | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | 50° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2545 | 2623 | 2702 | 2782 | 2863 | 2946 | 3030 | 3116 | 3203 | 3292 | 3382 | 3474 | 0 |
| 1 | 2546 | 2624 | 2703 | 2783 | 2864 | 2947 | 3031 | 3117 | 3204 | 3293 | 3384 | 3476 | 1 |
| 2 | 2548 | 2625 | 2704 | 2784 | 2866 | 2949 | 3033 | 3118 | 3206 | 3295 | 3385 | 3478 | 2 |
| 3 | 2549 | 2627 | 2706 | 2786 | 2867 | 2950 | 3034 | 3120 | 3207 | 3296 | 3387 | 3479 | 3 |
| 4 | 2550 | 2628 | 2707 | 2787 | 2869 | 2951 | 3036 | 3121 | 3209 | 3298 | 3388 | 3481 | 4 |
| 5 | 2551 | 2629 | 2708 | 2788 | 2870 | 2953 | 3037 | 3123 | 3210 | 3299 | 3390 | 3482 | 5 |
| 6 | 2553 | 2631 | 2710 | 2790 | 2871 | 2954 | 3038 | 3124 | 3212 | 3301 | 3391 | 3484 | 6 |
| 7 | 2554 | 2632 | 2711 | 2791 | 2873 | 2956 | 3040 | 3126 | 3213 | 3302 | 3393 | 3485 | 7 |
| 8 | 2555 | 2633 | 2712 | 2792 | 2874 | 2957 | 3041 | 3127 | 3214 | 3303 | 3394 | 3487 | 8 |
| 9 | 2557 | 2634 | 2714 | 2794 | 2875 | 2958 | 3043 | 3129 | 3216 | 3305 | 3396 | 3488 | 9 |
| 10 | 2558 | 2636 | 2715 | 2795 | 2877 | 2960 | 3044 | 3130 | 3217 | 3306 | 3397 | 3490 | 10 |
| 11 | 2559 | 2637 | 2716 | 2797 | 2878 | 2961 | 3046 | 3131 | 3219 | 3308 | 3399 | 3492 | 11 |
| 12 | 2560 | 2638 | 2718 | 2798 | 2880 | 2963 | 3047 | 3133 | 3220 | 3309 | 3400 | 3493 | 12 |
| 13 | 2562 | 2640 | 2719 | 2799 | 2881 | 2964 | 3048 | 3134 | 3222 | 3311 | 3402 | 3495 | 13 |
| 14 | 2563 | 2641 | 2720 | 2801 | 2882 | 2965 | 3050 | 3136 | 3223 | 3312 | 3403 | 3496 | 14 |
| 15 | 2564 | 2642 | 2722 | 2802 | 2884 | 2967 | 3051 | 3137 | 3225 | 3314 | 3405 | 3498 | 15 |
| 16 | 2566 | 2644 | 2723 | 2803 | 2885 | 2968 | 3053 | 3139 | 3226 | 3316 | 3407 | 3499 | 16 |
| 17 | 2567 | 2645 | 2724 | 2805 | 2886 | 2970 | 3054 | 3140 | 3228 | 3317 | 3408 | 3501 | 17 |
| 18 | 2568 | 2646 | 2726 | 2806 | 2888 | 2971 | 3055 | 3142 | 3229 | 3319 | 3410 | 3503 | 18 |
| 19 | 2569 | 2648 | 2727 | 2807 | 2889 | 2972 | 3057 | 3143 | 3231 | 3320 | 3411 | 3504 | 19 |
| 20 | 2571 | 2649 | 2728 | 2809 | 2891 | 2974 | 3058 | 3144 | 3232 | 3322 | 3413 | 3506 | 20 |
| 21 | 2572 | 2650 | 2729 | 2810 | 2892 | 2975 | 3060 | 3146 | 3234 | 3323 | 3414 | 3507 | 21 |
| 22 | 2573 | 2651 | 2731 | 2811 | 2893 | 2976 | 3061 | 3147 | 3235 | 3325 | 3416 | 3509 | 22 |
| 23 | 2575 | 2653 | 2732 | 2813 | 2895 | 2978 | 3063 | 3149 | 3237 | 3326 | 3417 | 3510 | 23 |
| 24 | 2576 | 2654 | 2733 | 2814 | 2896 | 2979 | 3064 | 3150 | 3238 | 3328 | 3419 | 3512 | 24 |
| 25 | 2577 | 2655 | 2735 | 2815 | 2897 | 2981 | 3065 | 3152 | 3240 | 3329 | 3420 | 3514 | 25 |
| 26 | 2578 | 2657 | 2736 | 2817 | 2899 | 2982 | 3067 | 3153 | 3241 | 3331 | 3422 | 3515 | 26 |
| 27 | 2580 | 2658 | 2737 | 2818 | 2900 | 2983 | 3068 | 3155 | 3242 | 3332 | 3423 | 3517 | 27 |
| 28 | 2581 | 2659 | 2739 | 2820 | 2902 | 2985 | 3070 | 3156 | 3244 | 3334 | 3425 | 3518 | 28 |
| 29 | 2582 | 2661 | 2740 | 2821 | 2903 | 2986 | 3071 | 3157 | 3245 | 3335 | 3427 | 3520 | 29 |
| 30 | 2584 | 2662 | 2742 | 2822 | 2904 | 2988 | 3073 | 3159 | 3247 | 3337 | 3428 | 3521 | 30 |
| 31 | 2585 | 2663 | 2743 | 2824 | 2906 | 2989 | 3074 | 3160 | 3248 | 3338 | 3430 | 3523 | 31 |
| 32 | 2586 | 2665 | 2744 | 2825 | 2907 | 2991 | 3075 | 3162 | 3250 | 3340 | 3431 | 3525 | 32 |
| 33 | 2588 | 2666 | 2746 | 2826 | 2908 | 2992 | 3077 | 3163 | 3251 | 3341 | 3433 | 3526 | 33 |
| 34 | 2589 | 2667 | 2747 | 2828 | 2910 | 2993 | 3078 | 3165 | 3253 | 3343 | 3434 | 3528 | 34 |
| 35 | 2590 | 2669 | 2748 | 2829 | 2911 | 2995 | 3080 | 3166 | 3254 | 3344 | 3436 | 3529 | 35 |
| 36 | 2591 | 2670 | 2750 | 2830 | 2913 | 2996 | 3081 | 3168 | 3256 | 3346 | 3437 | 3531 | 36 |
| 37 | 2593 | 2671 | 2751 | 2832 | 2914 | 2998 | 3083 | 3169 | 3257 | 3347 | 3439 | 3532 | 37 |
| 38 | 2594 | 2673 | 2752 | 2833 | 2915 | 2999 | 3084 | 3171 | 3259 | 3349 | 3440 | 3534 | 38 |
| 39 | 2595 | 2674 | 2754 | 2834 | 2917 | 3000 | 3085 | 3172 | 3260 | 3350 | 3442 | 3536 | 39 |
| 40 | 2597 | 2675 | 2755 | 2836 | 2918 | 3002 | 3087 | 3173 | 3262 | 3352 | 3443 | 3537 | 40 |
| 41 | 2598 | 2676 | 2756 | 2837 | 2919 | 3003 | 3088 | 3175 | 3263 | 3353 | 3445 | 3539 | 41 |
| 42 | 2599 | 2678 | 2758 | 2839 | 2921 | 3005 | 3090 | 3176 | 3265 | 3355 | 3447 | 3540 | 42 |
| 43 | 2601 | 2679 | 2759 | 2840 | 2922 | 3006 | 3091 | 3178 | 3266 | 3356 | 3448 | 3542 | 43 |
| 44 | 2602 | 2680 | 2760 | 2841 | 2924 | 3007 | 3093 | 3179 | 3268 | 3358 | 3450 | 3543 | 44 |
| 45 | 2603 | 2682 | 2762 | 2843 | 2925 | 3009 | 3094 | 3181 | 3269 | 3359 | 3451 | 3545 | 45 |
| 46 | 2604 | 2683 | 2763 | 2844 | 2926 | 3010 | 3095 | 3182 | 3271 | 3361 | 3453 | 3547 | 46 |
| 47 | 2606 | 2684 | 2764 | 2845 | 2928 | 3012 | 3097 | 3184 | 3272 | 3362 | 3454 | 3548 | 47 |
| 48 | 2607 | 2686 | 2766 | 2847 | 2929 | 3013 | 3098 | 3185 | 3274 | 3364 | 3456 | 3550 | 48 |
| 49 | 2608 | 2687 | 2767 | 2848 | 2931 | 3014 | 3100 | 3187 | 3275 | 3365 | 3457 | 3551 | 49 |
| 50 | 2610 | 2688 | 2768 | 2849 | 2932 | 3016 | 3101 | 3188 | 3277 | 3367 | 3459 | 3553 | 50 |
| 51 | 2611 | 2690 | 2770 | 2851 | 2933 | 3017 | 3103 | 3190 | 3278 | 3368 | 3460 | 3555 | 51 |
| 52 | 2612 | 2691 | 2771 | 2852 | 2935 | 3019 | 3104 | 3191 | 3280 | 3370 | 3462 | 3556 | 52 |
| 53 | 2614 | 2692 | 2772 | 2854 | 2936 | 3020 | 3105 | 3192 | 3281 | 3371 | 3464 | 3558 | 53 |
| 54 | 2615 | 2694 | 2774 | 2855 | 2937 | 3021 | 3107 | 3194 | 3283 | 3373 | 3465 | 3559 | 54 |
| 55 | 2616 | 2695 | 2775 | 2856 | 2939 | 3023 | 3108 | 3195 | 3284 | 3374 | 3467 | 3561 | 55 |
| 56 | 2617 | 2696 | 2776 | 2858 | 2940 | 3024 | 3110 | 3197 | 3286 | 3376 | 3468 | 3562 | 56 |
| 57 | 2619 | 2698 | 2778 | 2859 | 2942 | 3026 | 3111 | 3198 | 3287 | 3378 | 3470 | 3564 | 57 |
| 58 | 2620 | 2699 | 2779 | 2860 | 2943 | 3027 | 3113 | 3200 | 3289 | 3379 | 3471 | 3566 | 58 |
| 59 | 2621 | 2700 | 2780 | 2862 | 2944 | 3029 | 3114 | 3201 | 3290 | 3381 | 3473 | 3567 | 59 |
| M | 39° | 40° | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | 50° | M |

# TABLE III.

## MERIDIONAL PARTS.

| M | 51° | 52° | 53° | 54° | 55° | 56° | 57° | 58° | 59° | 60° | 61° | 62° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3569 | 3665 | 3764 | 3865 | 3968 | 4074 | 4183 | 4294 | 4409 | 4527 | 4649 | 4775 | 0 |
| 1 | 3570 | 3667 | 3765 | 3866 | 3970 | 4076 | 4184 | 4296 | 4411 | 4529 | 4651 | 4777 | 1 |
| 2 | 3572 | 3668 | 3767 | 3868 | 3971 | 4077 | 4186 | 4298 | 4413 | 4531 | 4653 | 4779 | 2 |
| 3 | 3574 | 3670 | 3769 | 3870 | 3973 | 4079 | 4188 | 4300 | 4415 | 4533 | 4655 | 4781 | 3 |
| 4 | 3575 | 3672 | 3770 | 3871 | 3975 | 4081 | 4190 | 4302 | 4417 | 4535 | 4657 | 4784 | 4 |
| 5 | 3577 | 3673 | 3772 | 3873 | 3977 | 4083 | 4192 | 4304 | 4419 | 4537 | 4660 | 4786 | 5 |
| 6 | 3578 | 3675 | 3774 | 3875 | 3978 | 4085 | 4194 | 4306 | 4421 | 4539 | 4662 | 4788 | 6 |
| 7 | 3580 | 3677 | 3775 | 3877 | 3980 | 4086 | 4195 | 4308 | 4423 | 4541 | 4664 | 4790 | 7 |
| 8 | 3582 | 3678 | 3777 | 3878 | 3982 | 4088 | 4197 | 4309 | 4425 | 4543 | 4666 | 4792 | 8 |
| 9 | 3583 | 3680 | 3779 | 3880 | 3984 | 4090 | 4199 | 4311 | 4427 | 4545 | 4668 | 4794 | 9 |
| 10 | 3585 | 3681 | 3780 | 3882 | 3985 | 4092 | 4201 | 4313 | 4429 | 4547 | 4670 | 4796 | 10 |
| 11 | 3586 | 3683 | 3782 | 3883 | 3987 | 4094 | 4203 | 4315 | 4431 | 4549 | 4672 | 4798 | 11 |
| 12 | 3588 | 3685 | 3784 | 3885 | 3989 | 4095 | 4205 | 4317 | 4433 | 4551 | 4674 | 4801 | 12 |
| 13 | 3590 | 3686 | 3785 | 3887 | 3991 | 4097 | 4207 | 4319 | 4434 | 4553 | 4676 | 4803 | 13 |
| 14 | 3591 | 3688 | 3787 | 3889 | 3992 | 4099 | 4208 | 4321 | 4436 | 4555 | 4678 | 4805 | 14 |
| 15 | 3593 | 3690 | 3789 | 3890 | 3994 | 4101 | 4210 | 4323 | 4438 | 4557 | 4680 | 4807 | 15 |
| 16 | 3594 | 3691 | 3790 | 3892 | 3996 | 4103 | 4212 | 4325 | 4440 | 4559 | 4682 | 4809 | 16 |
| 17 | 3596 | 3693 | 3792 | 3894 | 3998 | 4104 | 4214 | 4327 | 4442 | 4562 | 4684 | 4811 | 17 |
| 18 | 3598 | 3695 | 3794 | 3895 | 3999 | 4106 | 4216 | 4328 | 4444 | 4564 | 4687 | 4814 | 18 |
| 19 | 3599 | 3696 | 3795 | 3897 | 4001 | 4108 | 4218 | 4330 | 4446 | 4566 | 4689 | 4816 | 19 |
| 20 | 3601 | 3698 | 3797 | 3899 | 4003 | 4110 | 4220 | 4332 | 4448 | 4568 | 4691 | 4818 | 20 |
| 21 | 3602 | 3699 | 3799 | 3901 | 4005 | 4112 | 4221 | 4334 | 4450 | 4570 | 4693 | 4820 | 21 |
| 22 | 3604 | 3701 | 3800 | 3902 | 4006 | 4113 | 4223 | 4336 | 4452 | 4572 | 4695 | 4822 | 22 |
| 23 | 3606 | 3703 | 3802 | 3904 | 4008 | 4115 | 4225 | 4338 | 4454 | 4574 | 4697 | 4824 | 23 |
| 24 | 3607 | 3704 | 3804 | 3906 | 4010 | 4117 | 4227 | 4340 | 4456 | 4576 | 4699 | 4826 | 24 |
| 25 | 3609 | 3706 | 3806 | 3907 | 4012 | 4119 | 4229 | 4342 | 4458 | 4578 | 4701 | 4829 | 25 |
| 26 | 3610 | 3708 | 3807 | 3909 | 4014 | 4121 | 4231 | 4344 | 4460 | 4580 | 4703 | 4831 | 26 |
| 27 | 3612 | 3709 | 3809 | 3911 | 4015 | 4122 | 4232 | 4346 | 4462 | 4582 | 4705 | 4833 | 27 |
| 28 | 3614 | 3711 | 3811 | 3913 | 4017 | 4124 | 4234 | 4347 | 4464 | 4584 | 4707 | 4835 | 28 |
| 29 | 3615 | 3713 | 3812 | 3914 | 4019 | 4126 | 4236 | 4349 | 4466 | 4586 | 4710 | 4837 | 29 |
| 30 | 3617 | 3714 | 3814 | 3916 | 4021 | 4128 | 4238 | 4351 | 4468 | 4588 | 4712 | 4839 | 30 |
| 31 | 3618 | 3716 | 3816 | 3918 | 4022 | 4130 | 4240 | 4353 | 4470 | 4590 | 4714 | 4842 | 31 |
| 32 | 3620 | 3717 | 3817 | 3919 | 4024 | 4132 | 4242 | 4355 | 4472 | 4592 | 4716 | 4844 | 32 |
| 33 | 3622 | 3719 | 3819 | 3921 | 4026 | 4133 | 4244 | 4357 | 4474 | 4594 | 4718 | 4846 | 33 |
| 34 | 3623 | 3721 | 3821 | 3923 | 4028 | 4135 | 4246 | 4359 | 4476 | 4596 | 4720 | 4848 | 34 |
| 35 | 3625 | 3722 | 3822 | 3925 | 4029 | 4137 | 4247 | 4361 | 4478 | 4598 | 4722 | 4850 | 35 |
| 36 | 3626 | 3724 | 3824 | 3926 | 4031 | 4139 | 4249 | 4363 | 4480 | 4600 | 4724 | 4852 | 36 |
| 37 | 3628 | 3726 | 3826 | 3928 | 4033 | 4141 | 4251 | 4365 | 4482 | 4602 | 4726 | 4855 | 37 |
| 38 | 3630 | 3727 | 3827 | 3930 | 4035 | 4142 | 4253 | 4367 | 4484 | 4604 | 4728 | 4857 | 38 |
| 39 | 3631 | 3729 | 3829 | 3932 | 4037 | 4144 | 4255 | 4369 | 4486 | 4606 | 4731 | 4859 | 39 |
| 40 | 3633 | 3731 | 3831 | 3933 | 4038 | 4146 | 4257 | 4370 | 4488 | 4608 | 4733 | 4861 | 40 |
| 41 | 3634 | 3732 | 3832 | 3935 | 4040 | 4148 | 4259 | 4372 | 4490 | 4610 | 4735 | 4863 | 41 |
| 42 | 3636 | 3734 | 3834 | 3937 | 4042 | 4150 | 4260 | 4374 | 4492 | 4612 | 4737 | 4865 | 42 |
| 43 | 3638 | 3736 | 3836 | 3938 | 4044 | 4152 | 4262 | 4376 | 4494 | 4614 | 4739 | 4868 | 43 |
| 44 | 3639 | 3737 | 3838 | 3940 | 4045 | 4153 | 4264 | 4378 | 4495 | 4616 | 4741 | 4870 | 44 |
| 45 | 3641 | 3739 | 3839 | 3942 | 4047 | 4155 | 4266 | 4380 | 4497 | 4618 | 4743 | 4872 | 45 |
| 46 | 3643 | 3741 | 3841 | 3944 | 4049 | 4157 | 4268 | 4382 | 4499 | 4620 | 4745 | 4874 | 46 |
| 47 | 3644 | 3742 | 3843 | 3945 | 4051 | 4159 | 4270 | 4384 | 4501 | 4623 | 4747 | 4876 | 47 |
| 48 | 3646 | 3744 | 3844 | 3947 | 4052 | 4161 | 4272 | 4386 | 4503 | 4625 | 4750 | 4879 | 48 |
| 49 | 3647 | 3746 | 3846 | 3949 | 4054 | 4162 | 4274 | 4388 | 4505 | 4627 | 4752 | 4881 | 49 |
| 50 | 3649 | 3747 | 3848 | 3951 | 4056 | 4164 | 4275 | 4390 | 4507 | 4629 | 4754 | 4883 | 50 |
| 51 | 3651 | 3749 | 3849 | 3952 | 4058 | 4166 | 4277 | 4392 | 4509 | 4631 | 4756 | 4885 | 51 |
| 52 | 3652 | 3750 | 3851 | 3954 | 4060 | 4168 | 4279 | 4394 | 4511 | 4633 | 4758 | 4887 | 52 |
| 53 | 3654 | 3752 | 3853 | 3956 | 4061 | 4170 | 4281 | 4396 | 4513 | 4635 | 4760 | 4890 | 53 |
| 54 | 3655 | 3754 | 3854 | 3958 | 4063 | 4172 | 4283 | 4398 | 4515 | 4637 | 4762 | 4892 | 54 |
| 55 | 3657 | 3755 | 3856 | 3959 | 4065 | 4173 | 4285 | 4399 | 4517 | 4639 | 4764 | 4894 | 55 |
| 56 | 3659 | 3757 | 3858 | 3961 | 4067 | 4175 | 4287 | 4401 | 4519 | 4641 | 4766 | 4896 | 56 |
| 57 | 3660 | 3759 | 3860 | 3963 | 4069 | 4177 | 4289 | 4403 | 4521 | 4643 | 4769 | 4898 | 57 |
| 58 | 3662 | 3760 | 3861 | 3964 | 4070 | 4179 | 4291 | 4405 | 4523 | 4645 | 4771 | 4901 | 58 |
| 59 | 3664 | 3762 | 3863 | 3966 | 4072 | 4181 | 4292 | 4407 | 4525 | 4647 | 4773 | 4903 | 59 |
| M | 51° | 52° | 53° | 54° | 55° | 56° | 57° | 58° | 59° | 60° | 61° | 62° | M |

# TABLE III.

## MERIDIONAL PARTS.

| M | 63° | 64° | 65° | 66° | 67° | 68° | 69° | 70° | 71° | 72° | 73° | 74° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4905 | 5039 | 5179 | 5324 | 5474 | 5631 | 5795 | 5966 | 6146 | 6335 | 6534 | 6746 | 0 |
| 1 | 4907 | 5042 | 5181 | 5326 | 5477 | 5633 | 5797 | 5969 | 6149 | 6338 | 6538 | 6749 | 1 |
| 2 | 4909 | 5044 | 5184 | 5328 | 5479 | 5636 | 5800 | 5972 | 6152 | 6341 | 6541 | 6753 | 2 |
| 3 | 4912 | 5046 | 5186 | 5331 | 5482 | 5639 | 5803 | 5975 | 6155 | 6345 | 6545 | 6757 | 3 |
| 4 | 4914 | 5049 | 5188 | 5333 | 5484 | 5642 | 5806 | 5978 | 6158 | 6348 | 6548 | 6760 | 4 |
| 5 | 4916 | 5051 | 5191 | 5336 | 5487 | 5644 | 5809 | 5981 | 6161 | 6351 | 6552 | 6764 | 5 |
| 6 | 4918 | 5053 | 5193 | 5338 | 5489 | 5647 | 5811 | 5984 | 6164 | 6354 | 6555 | 6768 | 6 |
| 7 | 4920 | 5055 | 5195 | 5341 | 5492 | 5650 | 5814 | 5986 | 6167 | 6358 | 6558 | 6771 | 7 |
| 8 | 4923 | 5058 | 5198 | 5343 | 5495 | 5652 | 5817 | 5989 | 6170 | 6361 | 6562 | 6775 | 8 |
| 9 | 4925 | 5060 | 5200 | 5346 | 5497 | 5655 | 5820 | 5992 | 6173 | 6364 | 6565 | 6779 | 9 |
| 10 | 4927 | 5062 | 5203 | 5348 | 5500 | 5658 | 5823 | 5995 | 6177 | 6367 | 6569 | 6782 | 10 |
| 11 | 4929 | 5065 | 5205 | 5351 | 5502 | 5660 | 5825 | 5998 | 6180 | 6371 | 6572 | 6786 | 11 |
| 12 | 4931 | 5067 | 5207 | 5353 | 5505 | 5663 | 5828 | 6001 | 6183 | 6374 | 6576 | 6790 | 12 |
| 13 | 4934 | 5069 | 5210 | 5356 | 5507 | 5666 | 5831 | 6004 | 6186 | 6377 | 6579 | 6793 | 13 |
| 14 | 4936 | 5071 | 5212 | 5358 | 5510 | 5668 | 5834 | 6007 | 6189 | 6380 | 6583 | 6797 | 14 |
| 15 | 4938 | 5074 | 5214 | 5361 | 5513 | 5671 | 5837 | 6010 | 6192 | 6384 | 6586 | 6801 | 15 |
| 16 | 4940 | 5076 | 5217 | 5363 | 5515 | 5674 | 5839 | 6013 | 6195 | 6387 | 6590 | 6804 | 16 |
| 17 | 4943 | 5078 | 5219 | 5366 | 5518 | 5676 | 5842 | 6016 | 6198 | 6390 | 6593 | 6808 | 17 |
| 18 | 4945 | 5081 | 5222 | 5368 | 5520 | 5679 | 5845 | 6019 | 6201 | 6394 | 6597 | 6812 | 18 |
| 19 | 4947 | 5083 | 5224 | 5371 | 5523 | 5682 | 5848 | 6022 | 6205 | 6397 | 6600 | 6815 | 19 |
| 20 | 4949 | 5085 | 5226 | 5373 | 5526 | 5685 | 5851 | 6025 | 6208 | 6400 | 6603 | 6819 | 20 |
| 21 | 4951 | 5088 | 5229 | 5376 | 5528 | 5687 | 5854 | 6028 | 6211 | 6403 | 6607 | 6823 | 21 |
| 22 | 4954 | 5090 | 5231 | 5378 | 5531 | 5690 | 5856 | 6031 | 6214 | 6407 | 6610 | 6826 | 22 |
| 23 | 4956 | 5092 | 5234 | 5380 | 5533 | 5693 | 5859 | 6034 | 6217 | 6410 | 6614 | 6830 | 23 |
| 24 | 4958 | 5095 | 5236 | 5383 | 5536 | 5695 | 5862 | 6037 | 6220 | 6413 | 6617 | 6834 | 24 |
| 25 | 4960 | 5097 | 5238 | 5385 | 5539 | 5698 | 5865 | 6040 | 6223 | 6417 | 6621 | 6838 | 25 |
| 26 | 4963 | 5099 | 5241 | 5388 | 5541 | 5701 | 5868 | 6043 | 6226 | 6420 | 6624 | 6841 | 26 |
| 27 | 4965 | 5102 | 5243 | 5390 | 5544 | 5704 | 5871 | 6046 | 6230 | 6423 | 6628 | 6845 | 27 |
| 28 | 4967 | 5104 | 5246 | 5393 | 5546 | 5706 | 5874 | 6049 | 6233 | 6427 | 6631 | 6849 | 28 |
| 29 | 4969 | 5106 | 5248 | 5395 | 5549 | 5709 | 5876 | 6052 | 6236 | 6430 | 6635 | 6853 | 29 |
| 30 | 4972 | 5108 | 5250 | 5398 | 5552 | 5712 | 5879 | 6055 | 6239 | 6433 | 6639 | 6856 | 30 |
| 31 | 4974 | 5111 | 5253 | 5401 | 5554 | 5715 | 5882 | 6058 | 6242 | 6437 | 6642 | 6860 | 31 |
| 32 | 4976 | 5113 | 5255 | 5403 | 5557 | 5717 | 5885 | 6061 | 6245 | 6440 | 6646 | 6864 | 32 |
| 33 | 4978 | 5115 | 5258 | 5406 | 5559 | 5720 | 5888 | 6064 | 6249 | 6443 | 6649 | 6868 | 33 |
| 34 | 4981 | 5118 | 5260 | 5408 | 5562 | 5723 | 5891 | 6067 | 6252 | 6447 | 6653 | 6871 | 34 |
| 35 | 4983 | 5120 | 5263 | 5411 | 5565 | 5725 | 5894 | 6070 | 6255 | 6450 | 6656 | 6875 | 35 |
| 36 | 4985 | 5122 | 5265 | 5413 | 5567 | 5728 | 5896 | 6073 | 6258 | 6453 | 6660 | 6879 | 36 |
| 37 | 4987 | 5125 | 5267 | 5416 | 5570 | 5731 | 5899 | 6076 | 6261 | 6457 | 6663 | 6883 | 37 |
| 38 | 4990 | 5127 | 5270 | 5418 | 5573 | 5734 | 5902 | 6079 | 6264 | 6460 | 6667 | 6886 | 38 |
| 39 | 4992 | 5129 | 5272 | 5421 | 5575 | 5736 | 5905 | 6082 | 6268 | 6463 | 6670 | 6890 | 39 |
| 40 | 4994 | 5132 | 5275 | 5423 | 5578 | 5739 | 5908 | 6085 | 6271 | 6467 | 6674 | 6894 | 40 |
| 41 | 4996 | 5134 | 5277 | 5426 | 5580 | 5742 | 5911 | 6088 | 6274 | 6470 | 6677 | 6898 | 41 |
| 42 | 4999 | 5136 | 5280 | 5428 | 5583 | 5745 | 5914 | 6091 | 6277 | 6473 | 6681 | 6901 | 42 |
| 43 | 5001 | 5139 | 5282 | 5431 | 5586 | 5747 | 5917 | 6094 | 6280 | 6477 | 6685 | 6905 | 43 |
| 44 | 5003 | 5141 | 5284 | 5433 | 5588 | 5750 | 5919 | 6097 | 6283 | 6480 | 6688 | 6909 | 44 |
| 45 | 5005 | 5143 | 5287 | 5436 | 5591 | 5753 | 5922 | 6100 | 6287 | 6483 | 6692 | 6913 | 45 |
| 46 | 5008 | 5146 | 5289 | 5438 | 5594 | 5756 | 5925 | 6103 | 6290 | 6487 | 6695 | 6917 | 46 |
| 47 | 5010 | 5148 | 5292 | 5441 | 5596 | 5758 | 5928 | 6106 | 6293 | 6490 | 6699 | 6920 | 47 |
| 48 | 5012 | 5151 | 5294 | 5443 | 5599 | 5761 | 5931 | 6109 | 6296 | 6494 | 6702 | 6924 | 48 |
| 49 | 5014 | 5153 | 5297 | 5446 | 5602 | 5764 | 5934 | 6112 | 6299 | 6497 | 6706 | 6928 | 49 |
| 50 | 5017 | 5155 | 5299 | 5448 | 5604 | 5767 | 5937 | 6115 | 6303 | 6500 | 6710 | 6932 | 50 |
| 51 | 5019 | 5158 | 5301 | 5451 | 5607 | 5770 | 5940 | 6118 | 6306 | 6504 | 6713 | 6936 | 51 |
| 52 | 5021 | 5160 | 5304 | 5454 | 5610 | 5772 | 5943 | 6121 | 6309 | 6507 | 6717 | 6940 | 52 |
| 53 | 5023 | 5162 | 5306 | 5456 | 5612 | 5775 | 5946 | 6124 | 6312 | 6511 | 6720 | 6943 | 53 |
| 54 | 5026 | 5165 | 5309 | 5459 | 5615 | 5778 | 5948 | 6127 | 6315 | 6514 | 6724 | 6947 | 54 |
| 55 | 5028 | 5167 | 5311 | 5461 | 5617 | 5781 | 5951 | 6130 | 6319 | 6517 | 6728 | 6951 | 55 |
| 56 | 5030 | 5169 | 5314 | 5464 | 5620 | 5783 | 5954 | 6133 | 6322 | 6521 | 6731 | 6955 | 56 |
| 57 | 5033 | 5172 | 5316 | 5466 | 5623 | 5786 | 5957 | 6136 | 6325 | 6524 | 6735 | 6959 | 57 |
| 58 | 5035 | 5174 | 5319 | 5469 | 5625 | 5789 | 5960 | 6140 | 6328 | 6528 | 6738 | 6963 | 58 |
| 59 | 5037 | 5176 | 5321 | 5471 | 5628 | 5792 | 5963 | 6143 | 6332 | 6531 | 6742 | 6966 | 59 |
| M | 63° | 64° | 65° | 66° | 67° | 68° | 69° | 70° | 71° | 72° | 73° | 74° | M |

# TABLE III.

## MERIDIONAL PARTS.

| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6970 | 7210 | 7467 | 7745 | 8046 | 8375 | 8739 | 9145 | 9606 | 10137 | 10765 | 11533 | 0 |
| 1 | 6974 | 7214 | 7472 | 7749 | 8051 | 8381 | 8745 | 9153 | 9614 | 10147 | 10776 | 11547 | 1 |
| 2 | 6978 | 7218 | 7476 | 7754 | 8056 | 8387 | 8752 | 9160 | 9622 | 10156 | 10788 | 11561 | 2 |
| 3 | 6982 | 7222 | 7481 | 7759 | 8061 | 8393 | 8758 | 9167 | 9631 | 10166 | 10799 | 11576 | 3 |
| 4 | 6986 | 7227 | 7485 | 7764 | 8067 | 8398 | 8765 | 9174 | 9639 | 10175 | 10811 | 11590 | 4 |
| 5 | 6990 | 7231 | 7490 | 7769 | 8072 | 8404 | 8771 | 9182 | 9647 | 10185 | 10823 | 11605 | 5 |
| 6 | 6994 | 7235 | 7494 | 7774 | 8077 | 8410 | 8778 | 9189 | 9655 | 10195 | 10834 | 11620 | 6 |
| 7 | 6997 | 7239 | 7498 | 7778 | 8083 | 8416 | 8784 | 9196 | 9664 | 10205 | 10846 | 11634 | 7 |
| 8 | 7001 | 7243 | 7503 | 7783 | 8088 | 8422 | 8791 | 9203 | 9672 | 10214 | 10858 | 11649 | 8 |
| 9 | 7005 | 7247 | 7507 | 7788 | 8093 | 8427 | 8797 | 9211 | 9680 | 10224 | 10870 | 11664 | 9 |
| 10 | 7009 | 7252 | 7512 | 7793 | 8099 | 8433 | 8804 | 9218 | 9689 | 10234 | 10881 | 11679 | 10 |
| 11 | 7013 | 7256 | 7516 | 7798 | 8104 | 8439 | 8810 | 9225 | 9697 | 10244 | 10893 | 11694 | 11 |
| 12 | 7017 | 7260 | 7521 | 7803 | 8109 | 8445 | 8817 | 9233 | 9706 | 10254 | 10905 | 11709 | 12 |
| 13 | 7021 | 7264 | 7525 | 7808 | 8115 | 8451 | 8823 | 9240 | 9714 | 10264 | 10917 | 11724 | 13 |
| 14 | 7025 | 7268 | 7530 | 7813 | 8120 | 8457 | 8830 | 9248 | 9723 | 10274 | 10929 | 11739 | 14 |
| 15 | 7029 | 7273 | 7535 | 7817 | 8125 | 8463 | 8836 | 9255 | 9731 | 10284 | 10941 | 11755 | 15 |
| 16 | 7033 | 7277 | 7539 | 7822 | 8131 | 8469 | 8843 | 9262 | 9740 | 10294 | 10953 | 11770 | 16 |
| 17 | 7037 | 7281 | 7544 | 7827 | 8136 | 8474 | 8849 | 9270 | 9748 | 10304 | 10965 | 11785 | 17 |
| 18 | 7041 | 7285 | 7548 | 7832 | 8141 | 8480 | 8856 | 9277 | 9757 | 10314 | 10978 | 11801 | 18 |
| 19 | 7045 | 7289 | 7553 | 7837 | 8147 | 8486 | 8863 | 9285 | 9765 | 10324 | 10990 | 11816 | 19 |
| 20 | 7048 | 7294 | 7557 | 7842 | 8152 | 8492 | 8869 | 9292 | 9774 | 10334 | 11002 | 11832 | 20 |
| 21 | 7052 | 7298 | 7562 | 7847 | 8158 | 8498 | 8876 | 9300 | 9783 | 10344 | 11014 | 11848 | 21 |
| 22 | 7056 | 7302 | 7566 | 7852 | 8163 | 8504 | 8883 | 9307 | 9791 | 10354 | 11027 | 11863 | 22 |
| 23 | 7060 | 7306 | 7571 | 7857 | 8168 | 8510 | 8889 | 9315 | 9800 | 10364 | 11039 | 11879 | 23 |
| 24 | 7064 | 7311 | 7576 | 7862 | 8174 | 8516 | 8896 | 9322 | 9809 | 10374 | 11052 | 11895 | 24 |
| 25 | 7068 | 7315 | 7580 | 7867 | 8179 | 8522 | 8903 | 9330 | 9817 | 10385 | 11064 | 11911 | 25 |
| 26 | 7072 | 7319 | 7585 | 7872 | 8185 | 8528 | 8909 | 9337 | 9826 | 10395 | 11077 | 11927 | 26 |
| 27 | 7076 | 7323 | 7589 | 7877 | 8190 | 8534 | 8916 | 9345 | 9835 | 10405 | 11089 | 11943 | 27 |
| 28 | 7080 | 7328 | 7594 | 7882 | 8196 | 8540 | 8923 | 9353 | 9844 | 10416 | 11102 | 11959 | 28 |
| 29 | 7084 | 7332 | 7599 | 7887 | 8201 | 8546 | 8930 | 9360 | 9852 | 10426 | 11115 | 11976 | 29 |
| 30 | 7088 | 7336 | 7603 | 7892 | 8207 | 8552 | 8936 | 9368 | 9861 | 10437 | 11127 | 11992 | 30 |
| 31 | 7092 | 7341 | 7608 | 7897 | 8212 | 8558 | 8943 | 9376 | 9870 | 10447 | 11140 | 12008 | 31 |
| 32 | 7096 | 7345 | 7612 | 7902 | 8218 | 8565 | 8950 | 9383 | 9879 | 10457 | 11153 | 12025 | 32 |
| 33 | 7100 | 7349 | 7617 | 7907 | 8223 | 8571 | 8957 | 9391 | 9888 | 10468 | 11166 | 12041 | 33 |
| 34 | 7104 | 7353 | 7622 | 7912 | 8229 | 8577 | 8963 | 9399 | 9897 | 10478 | 11179 | 12058 | 34 |
| 35 | 7108 | 7358 | 7626 | 7917 | 8234 | 8583 | 8970 | 9407 | 9906 | 10489 | 11192 | 12075 | 35 |
| 36 | 7112 | 7362 | 7631 | 7922 | 8240 | 8589 | 8977 | 9415 | 9915 | 10500 | 11205 | 12092 | 36 |
| 37 | 7116 | 7366 | 7636 | 7927 | 8245 | 8595 | 8984 | 9422 | 9924 | 10510 | 11218 | 12109 | 37 |
| 38 | 7120 | 7371 | 7640 | 7932 | 8251 | 8601 | 8991 | 9430 | 9933 | 10521 | 11231 | 12126 | 38 |
| 39 | 7124 | 7375 | 7645 | 7937 | 8256 | 8607 | 8998 | 9437 | 9942 | 10532 | 11244 | 12143 | 39 |
| 40 | 7128 | 7379 | 7650 | 7942 | 8262 | 8614 | 9005 | 9445 | 9951 | 10542 | 11257 | 12160 | 40 |
| 41 | 7132 | 7384 | 7654 | 7948 | 8267 | 8620 | 9012 | 9453 | 9960 | 10553 | 11270 | 12177 | 41 |
| 42 | 7136 | 7388 | 7659 | 7953 | 8273 | 8626 | 9018 | 9461 | 9969 | 10564 | 11284 | 12194 | 42 |
| 43 | 7140 | 7392 | 7664 | 7958 | 8279 | 8632 | 9025 | 9469 | 9978 | 10575 | 11297 | 12212 | 43 |
| 44 | 7145 | 7397 | 7668 | 7963 | 8284 | 8638 | 9032 | 9477 | 9987 | 10586 | 11310 | 12229 | 44 |
| 45 | 7149 | 7401 | 7673 | 7968 | 8290 | 8644 | 9039 | 9485 | 9996 | 10597 | 11324 | 12247 | 45 |
| 46 | 7153 | 7406 | 7678 | 7973 | 8295 | 8651 | 9046 | 9493 | 10005 | 10608 | 11338 | 12265 | 46 |
| 47 | 7157 | 7410 | 7683 | 7978 | 8301 | 8657 | 9053 | 9501 | 10015 | 10619 | 11351 | 12282 | 47 |
| 48 | 7161 | 7414 | 7687 | 7983 | 8307 | 8663 | 9060 | 9509 | 10024 | 10630 | 11365 | 12300 | 48 |
| 49 | 7165 | 7419 | 7692 | 7989 | 8312 | 8669 | 9067 | 9517 | 10033 | 10641 | 11378 | 12318 | 49 |
| 50 | 7169 | 7423 | 7697 | 7994 | 8318 | 8676 | 9074 | 9525 | 10043 | 10652 | 11392 | 12336 | 50 |
| 51 | 7173 | 7427 | 7702 | 7999 | 8324 | 8682 | 9081 | 9533 | 10052 | 10663 | 11406 | 12354 | 51 |
| 52 | 7177 | 7432 | 7706 | 8004 | 8329 | 8688 | 9088 | 9541 | 10061 | 10674 | 11420 | 12373 | 52 |
| 53 | 7181 | 7436 | 7711 | 8009 | 8335 | 8695 | 9096 | 9549 | 10071 | 10685 | 11434 | 12391 | 53 |
| 54 | 7185 | 7441 | 7716 | 8014 | 8341 | 8701 | 9103 | 9557 | 10080 | 10696 | 11448 | 12409 | 54 |
| 55 | 7189 | 7445 | 7721 | 8020 | 8347 | 8707 | 9110 | 9565 | 10089 | 10708 | 11462 | 12428 | 55 |
| 56 | 7194 | 7449 | 7725 | 8025 | 8352 | 8714 | 9117 | 9573 | 10099 | 10719 | 11476 | 12446 | 56 |
| 57 | 7198 | 7454 | 7730 | 8030 | 8358 | 8720 | 9124 | 9581 | 10108 | 10730 | 11490 | 12465 | 57 |
| 58 | 7202 | 7458 | 7735 | 8035 | 8364 | 8726 | 9131 | 9589 | 10118 | 10742 | 11504 | 12484 | 58 |
| 59 | 7206 | 7463 | 7740 | 8040 | 8369 | 8733 | 9138 | 9598 | 10127 | 10753 | 11518 | 12503 | 59 |
| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |

## TABLE III

MERIDIONAL PARTS.

| M | 87° | 88° | 89° |
|---|---|---|---|
| 0 | 12522 | 13916 | 16300 |
| 1 | 12541 | 13945 | 16357 |
| 2 | 12561 | 13974 | 16416 |
| 3 | 12580 | 14004 | 16476 |
| 4 | 12599 | 14033 | 16537 |
| 5 | 12619 | 14063 | 16599 |
| 6 | 12639 | 14093 | 16662 |
| 7 | 12659 | 14123 | 16726 |
| 8 | 12679 | 14154 | 16792 |
| 9 | 12699 | 14185 | 16858 |
| 10 | 12719 | 14216 | 16926 |
| 11 | 12739 | 14247 | 16996 |
| 12 | 12759 | 14279 | 17067 |
| 13 | 12780 | 14311 | 17139 |
| 14 | 12801 | 14343 | 17213 |
| 15 | 12821 | 14376 | 17289 |
| 16 | 12842 | 14409 | 17366 |
| 17 | 12863 | 14442 | 17445 |
| 18 | 12885 | 14475 | 17526 |
| 19 | 12906 | 14509 | 17609 |
| 20 | 12927 | 14543 | 17694 |
| 21 | 12949 | 14578 | 17781 |
| 22 | 12970 | 14613 | 17870 |
| 23 | 12992 | 14648 | 17962 |
| 24 | 13014 | 14684 | 18056 |
| 25 | 13036 | 14720 | 18153 |
| 26 | 13059 | 14756 | 18252 |
| 27 | 13081 | 14793 | 18355 |
| 28 | 13104 | 14830 | 18461 |
| 29 | 13126 | 14868 | 18570 |
| 30 | 13149 | 14906 | 18683 |
| 31 | 13172 | 14944 | 18799 |
| 32 | 13195 | 14983 | 18920 |
| 33 | 13219 | 15022 | 19045 |
| 34 | 13242 | 15062 | 19174 |
| 35 | 13266 | 15102 | 19309 |
| 36 | 13290 | 15143 | 19450 |
| 37 | 13314 | 15184 | 19596 |
| 38 | 13338 | 15226 | 19749 |
| 39 | 13362 | 15268 | 19909 |
| 40 | 13386 | 15311 | 20076 |
| 41 | 13411 | 15354 | 20253 |
| 42 | 13436 | 15398 | 20439 |
| 43 | 13461 | 15442 | 20635 |
| 44 | 13486 | 15487 | 20844 |
| 45 | 13511 | 15532 | 21065 |
| 46 | 13537 | 15579 | 21303 |
| 47 | 13563 | 15625 | 21557 |
| 48 | 13589 | 15673 | 21833 |
| 49 | 13615 | 15721 | 22132 |
| 50 | 13641 | 15770 | 22459 |
| 51 | 13668 | 15819 | 22822 |
| 52 | 13695 | 15869 | 23226 |
| 53 | 13722 | 15920 | 23685 |
| 54 | 13749 | 15972 | 24215 |
| 55 | 13776 | 16024 | 24842 |
| 56 | 13804 | 16078 | 25609 |
| 57 | 13832 | 16132 | 26598 |
| 58 | 13860 | 16187 | 27992 |
| 59 | 13888 | 16243 | 30375 |
| M | 87° | 88° | 89° |

## TABLE III.*

CORRECTION OF THE MEAN REFRACTION.



| App. Alt. | Height of the Thermometer. 20° | 26° | 32° | 38° | 44° | 50° | 56° | 62° | 68° | 74° | 80° |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | +″ | +″ | +″ | +″ | +″ | ″ | −″ | −″ | −″ | −″ | −″ |
| 0 0 | 91 | 72 | 53 | 35 | 17 | 0 | 16 | 32 | 48 | 63 | 78 |
| 2 10 | 87 | 68 | 50 | 33 | 16 | 0 | 16 | 31 | 46 | 60 | 74 |
| 2 20 | 83 | 65 | 48 | 32 | 16 | 0 | 15 | 30 | 44 | 58 | 71 |
| 2 30 | 80 | 63 | 46 | 30 | 15 | 0 | 15 | 29 | 43 | 56 | 68 |
| 2 40 | 77 | 60 | 44 | 29 | 14 | 0 | 14 | 28 | 41 | 54 | 66 |
| 2 50 | 74 | 58 | 43 | 28 | 14 | 0 | 13 | 27 | 40 | 52 | 64 |
| 3 0 | 71 | 56 | 41 | 27 | 13 | 0 | 13 | 26 | 38 | 50 | 61 |
| 3 10 | 68 | 54 | 40 | 26 | 13 | 0 | 12 | 25 | 37 | 48 | 59 |
| 3 20 | 66 | 52 | 38 | 25 | 13 | 0 | 12 | 24 | 35 | 46 | 57 |
| 3 30 | 64 | 50 | 37 | 24 | 12 | 0 | 11 | 23 | 34 | 45 | 55 |
| 3 40 | 62 | 49 | 36 | 24 | 12 | 0 | 11 | 22 | 33 | 43 | 53 |
| 3 50 | 60 | 47 | 35 | 23 | 11 | 0 | 10 | 21 | 31 | 42 | 52 |
| 4 0 | 58 | 45 | 33 | 22 | 11 | 0 | 10 | 20 | 30 | 40 | 50 |
| 4 30 | 53 | 42 | 31 | 21 | 10 | 0 | 9 | 19 | 28 | 37 | 45 |
| 5 0 | 48 | 38 | 28 | 18 | 9 | 0 | 9 | 17 | 26 | 33 | 40 |
| 5 30 | 45 | 35 | 26 | 17 | 8 | 0 | 8 | 16 | 24 | 31 | 38 |
| 6 0 | 41 | 32 | 24 | 16 | 8 | 0 | 7 | 15 | 22 | 29 | 35 |
| 6 30 | 38 | 30 | 22 | 14 | 7 | 0 | 7 | 14 | 20 | 27 | 33 |
| 7 0 | 36 | 28 | 21 | 14 | 7 | 0 | 6 | 13 | 19 | 25 | 31 |
| 7 30 | 34 | 27 | 20 | 13 | 6 | 0 | 6 | 12 | 18 | 24 | 29 |
| 8 0 | 32 | 25 | 19 | 12 | 6 | 0 | 5 | 11 | 16 | 22 | 27 |
| 8 30 | 30 | 23 | 17 | 11 | 6 | 0 | 5 | 10 | 15 | 20 | 25 |
| 9 0 | 28 | 22 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 24 |
| 9 30 | 27 | 21 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 23 |
| 10 0 | 26 | 20 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 18 | 22 |
| 10 30 | 24 | 19 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 17 | 21 |
| 11 0 | 23 | 18 | 14 | 9 | 5 | 0 | 4 | 8 | 12 | 16 | 20 |
| 11 30 | 22 | 17 | 13 | 9 | 4 | 0 | 4 | 8 | 12 | 16 | 19 |
| 12 0 | 21 | 17 | 13 | 8 | 4 | 0 | 4 | 8 | 11 | 15 | 18 |
| 13 0 | 20 | 16 | 12 | 8 | 4 | 0 | 3 | 7 | 10 | 14 | 17 |
| 14 0 | 18 | 14 | 11 | 7 | 4 | 0 | 3 | 6 | 9 | 13 | 16 |
| 15 0 | 17 | 13 | 10 | 6 | 3 | 0 | 3 | 6 | 9 | 12 | 15 |
| 16 0 | 16 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 14 |
| 17 0 | 15 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 13 |
| 18 0 | 14 | 11 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 10 | 12 |
| 19 0 | 13 | 10 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 9 | 11 |
| 20 0 | 13 | 10 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 9 | 11 |
| 21 0 | 12 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 22 0 | 11 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 23 0 | 11 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 6 | 7 | 9 |
| 24 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 9 |
| 25 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 26 0 | 9 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 27 0 | 9 | 7 | 5 | 3 | 2 | 0 | 2 | 3 | 5 | 6 | 8 |
| 28 0 | 9 | 7 | 5 | 3 | 2 | 0 | 1 | 3 | 5 | 6 | 7 |
| 29 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 3 | 4 | 6 | 7 |
| 30 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 2 | 4 | 5 | 7 |
| 32 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 4 | 5 | 6 |
| 34 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 5 | 6 |
| 36 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 38 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 40 0 | 6 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 42 0 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 44 0 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 1 | 2 | 3 | 4 |
| 46 0 | 4 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 3 | 3 |
| 48 0 | 3 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 3 |
| 50 0 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| 52 0 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| 54 0 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 56 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 58 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 60 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | − | − | − | | + | + | + | | |
| | | | 28.3 | 28.7 | 29.2 | 29.6 | 30.0 | 30.5 | 30.9 | | |

Height of the Barometer.

# TABLE III.

## MERIDIONAL PARTS.

| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6970 | 7210 | 7467 | 7745 | 8046 | 8375 | 8739 | 9145 | 9606 | 10137 | 10765 | 11533 | 0 |
| 1 | 6974 | 7214 | 7472 | 7749 | 8051 | 8381 | 8745 | 9153 | 9614 | 10147 | 10776 | 11547 | 1 |
| 2 | 6978 | 7218 | 7476 | 7754 | 8056 | 8387 | 8752 | 9160 | 9622 | 10156 | 10788 | 11561 | 2 |
| 3 | 6982 | 7222 | 7481 | 7759 | 8061 | 8393 | 8758 | 9167 | 9631 | 10166 | 10799 | 11576 | 3 |
| 4 | 6986 | 7227 | 7485 | 7764 | 8067 | 8398 | 8765 | 9174 | 9639 | 10175 | 10811 | 11590 | 4 |
| 5 | 6990 | 7231 | 7490 | 7769 | 8072 | 8404 | 8771 | 9182 | 9647 | 10185 | 10823 | 11605 | 5 |
| 6 | 6994 | 7235 | 7494 | 7774 | 8077 | 8410 | 8778 | 9189 | 9655 | 10195 | 10834 | 11620 | 6 |
| 7 | 6997 | 7239 | 7498 | 7778 | 8083 | 8416 | 8784 | 9196 | 9664 | 10205 | 10846 | 11634 | 7 |
| 8 | 7001 | 7243 | 7503 | 7783 | 8088 | 8422 | 8791 | 9203 | 9672 | 10214 | 10858 | 11649 | 8 |
| 9 | 7005 | 7247 | 7507 | 7788 | 8093 | 8427 | 8797 | 9211 | 9680 | 10224 | 10870 | 11664 | 9 |
| 10 | 7009 | 7252 | 7512 | 7793 | 8099 | 8433 | 8804 | 9218 | 9689 | 10234 | 10881 | 11679 | 10 |
| 11 | 7013 | 7256 | 7516 | 7798 | 8104 | 8439 | 8810 | 9225 | 9697 | 10244 | 10893 | 11694 | 11 |
| 12 | 7017 | 7260 | 7521 | 7803 | 8109 | 8445 | 8817 | 9233 | 9706 | 10254 | 10905 | 11709 | 12 |
| 13 | 7021 | 7264 | 7525 | 7808 | 8115 | 8451 | 8823 | 9240 | 9714 | 10264 | 10917 | 11724 | 13 |
| 14 | 7025 | 7268 | 7530 | 7813 | 8120 | 8457 | 8830 | 9248 | 9723 | 10274 | 10929 | 11739 | 14 |
| 15 | 7029 | 7273 | 7535 | 7817 | 8125 | 8463 | 8836 | 9255 | 9731 | 10284 | 10941 | 11755 | 15 |
| 16 | 7033 | 7277 | 7539 | 7822 | 8131 | 8469 | 8843 | 9262 | 9740 | 10294 | 10953 | 11770 | 16 |
| 17 | 7037 | 7281 | 7544 | 7827 | 8136 | 8474 | 8849 | 9270 | 9748 | 10304 | 10965 | 11785 | 17 |
| 18 | 7041 | 7285 | 7548 | 7832 | 8141 | 8480 | 8856 | 9277 | 9757 | 10314 | 10978 | 11801 | 18 |
| 19 | 7045 | 7289 | 7553 | 7837 | 8147 | 8486 | 8863 | 9285 | 9765 | 10324 | 10990 | 11816 | 19 |
| 20 | 7048 | 7294 | 7557 | 7842 | 8152 | 8492 | 8869 | 9292 | 9774 | 10334 | 11002 | 11832 | 20 |
| 21 | 7052 | 7298 | 7562 | 7847 | 8158 | 8498 | 8876 | 9300 | 9783 | 10344 | 11014 | 11848 | 21 |
| 22 | 7056 | 7302 | 7566 | 7852 | 8163 | 8504 | 8883 | 9307 | 9791 | 10354 | 11027 | 11863 | 22 |
| 23 | 7060 | 7306 | 7571 | 7857 | 8168 | 8510 | 8889 | 9315 | 9800 | 10364 | 11039 | 11879 | 23 |
| 24 | 7064 | 7311 | 7576 | 7862 | 8174 | 8516 | 8896 | 9322 | 9809 | 10374 | 11052 | 11895 | 24 |
| 25 | 7068 | 7315 | 7580 | 7867 | 8179 | 8522 | 8903 | 9330 | 9817 | 10385 | 11064 | 11911 | 25 |
| 26 | 7072 | 7319 | 7585 | 7872 | 8185 | 8528 | 8909 | 9337 | 9826 | 10395 | 11077 | 11927 | 26 |
| 27 | 7076 | 7323 | 7589 | 7877 | 8190 | 8534 | 8916 | 9345 | 9835 | 10405 | 11089 | 11943 | 27 |
| 28 | 7080 | 7328 | 7594 | 7882 | 8196 | 8540 | 8923 | 9353 | 9844 | 10416 | 11102 | 11959 | 28 |
| 29 | 7084 | 7332 | 7599 | 7887 | 8201 | 8546 | 8930 | 9360 | 9852 | 10426 | 11115 | 11976 | 29 |
| 30 | 7088 | 7336 | 7603 | 7892 | 8207 | 8552 | 8936 | 9368 | 9861 | 10437 | 11127 | 11992 | 30 |
| 31 | 7092 | 7341 | 7608 | 7897 | 8212 | 8558 | 8943 | 9376 | 9870 | 10447 | 11140 | 12008 | 31 |
| 32 | 7096 | 7345 | 7612 | 7902 | 8218 | 8565 | 8950 | 9383 | 9879 | 10457 | 11153 | 12025 | 32 |
| 33 | 7100 | 7349 | 7617 | 7907 | 8223 | 8571 | 8957 | 9391 | 9888 | 10468 | 11166 | 12041 | 33 |
| 34 | 7104 | 7353 | 7622 | 7912 | 8229 | 8577 | 8963 | 9399 | 9897 | 10478 | 11179 | 12058 | 34 |
| 35 | 7108 | 7358 | 7626 | 7917 | 8234 | 8583 | 8970 | 9407 | 9906 | 10489 | 11192 | 12075 | 35 |
| 36 | 7112 | 7362 | 7631 | 7922 | 8240 | 8589 | 8977 | 9415 | 9915 | 10500 | 11205 | 12092 | 36 |
| 37 | 7116 | 7366 | 7636 | 7927 | 8245 | 8595 | 8984 | 9422 | 9924 | 10510 | 11218 | 12109 | 37 |
| 38 | 7120 | 7371 | 7640 | 7932 | 8251 | 8601 | 8991 | 9430 | 9933 | 10521 | 11231 | 12126 | 38 |
| 39 | 7124 | 7375 | 7645 | 7937 | 8256 | 8607 | 8998 | 9437 | 9942 | 10532 | 11244 | 12143 | 39 |
| 40 | 7128 | 7379 | 7650 | 7942 | 8262 | 8614 | 9005 | 9445 | 9951 | 10542 | 11257 | 12160 | 40 |
| 41 | 7132 | 7384 | 7654 | 7948 | 8267 | 8620 | 9012 | 9453 | 9960 | 10553 | 11270 | 12177 | 41 |
| 42 | 7136 | 7388 | 7659 | 7953 | 8273 | 8626 | 9018 | 9461 | 9969 | 10564 | 11284 | 12194 | 42 |
| 43 | 7140 | 7392 | 7664 | 7958 | 8279 | 8632 | 9025 | 9469 | 9978 | 10575 | 11297 | 12212 | 43 |
| 44 | 7145 | 7397 | 7668 | 7963 | 8284 | 8638 | 9032 | 9477 | 9987 | 10586 | 11310 | 12229 | 44 |
| 45 | 7149 | 7401 | 7673 | 7968 | 8290 | 8644 | 9039 | 9485 | 9996 | 10597 | 11324 | 12247 | 45 |
| 46 | 7153 | 7406 | 7678 | 7973 | 8295 | 8651 | 9046 | 9493 | 10005 | 10608 | 11338 | 12265 | 46 |
| 47 | 7157 | 7410 | 7683 | 7978 | 8301 | 8657 | 9053 | 9501 | 10015 | 10619 | 11351 | 12282 | 47 |
| 48 | 7161 | 7414 | 7687 | 7983 | 8307 | 8663 | 9060 | 9509 | 10024 | 10630 | 11365 | 12300 | 48 |
| 49 | 7165 | 7419 | 7692 | 7989 | 8312 | 8669 | 9067 | 9517 | 10033 | 10641 | 11378 | 12318 | 49 |
| 50 | 7169 | 7423 | 7697 | 7994 | 8318 | 8676 | 9074 | 9525 | 10043 | 10652 | 11392 | 12336 | 50 |
| 51 | 7173 | 7427 | 7702 | 7999 | 8324 | 8682 | 9081 | 9533 | 10052 | 10663 | 11406 | 12354 | 51 |
| 52 | 7177 | 7432 | 7706 | 8004 | 8329 | 8688 | 9088 | 9541 | 10061 | 10674 | 11420 | 12373 | 52 |
| 53 | 7181 | 7436 | 7711 | 8009 | 8335 | 8695 | 9096 | 9549 | 10071 | 10685 | 11434 | 12391 | 53 |
| 54 | 7185 | 7441 | 7716 | 8014 | 8341 | 8701 | 9103 | 9557 | 10080 | 10696 | 11448 | 12409 | 54 |
| 55 | 7189 | 7445 | 7721 | 8020 | 8347 | 8707 | 9110 | 9565 | 10089 | 10708 | 11462 | 12428 | 55 |
| 56 | 7194 | 7449 | 7725 | 8025 | 8352 | 8714 | 9117 | 9573 | 10099 | 10719 | 11476 | 12446 | 56 |
| 57 | 7198 | 7454 | 7730 | 8030 | 8358 | 8720 | 9124 | 9581 | 10108 | 10730 | 11490 | 12465 | 57 |
| 58 | 7202 | 7458 | 7735 | 8035 | 8364 | 8726 | 9131 | 9589 | 10118 | 10742 | 11504 | 12484 | 58 |
| 59 | 7206 | 7463 | 7740 | 8040 | 8369 | 8733 | 9138 | 9598 | 10127 | 10753 | 11518 | 12503 | 59 |
| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |

## TABLE III

MERIDIONAL PARTS.

| M | 87° | 88° | 89° |
|---|---|---|---|
| 0 | 12522 | 13916 | 16300 |
| 1 | 12541 | 13945 | 16357 |
| 2 | 12561 | 13974 | 16416 |
| 3 | 12580 | 14004 | 16476 |
| 4 | 12599 | 14033 | 16537 |
| 5 | 12619 | 14063 | 16599 |
| 6 | 12639 | 14093 | 16662 |
| 7 | 12659 | 14123 | 16726 |
| 8 | 12679 | 14154 | 16792 |
| 9 | 12699 | 14185 | 16858 |
| 10 | 12719 | 14216 | 16926 |
| 11 | 12739 | 14247 | 16996 |
| 12 | 12759 | 14279 | 17067 |
| 13 | 12780 | 14311 | 17139 |
| 14 | 12801 | 14343 | 17213 |
| 15 | 12821 | 14376 | 17289 |
| 16 | 12842 | 14409 | 17366 |
| 17 | 12863 | 14442 | 17445 |
| 18 | 12885 | 14475 | 17526 |
| 19 | 12906 | 14509 | 17609 |
| 20 | 12927 | 14543 | 17691 |
| 21 | 12949 | 14578 | 17781 |
| 22 | 12970 | 14613 | 17870 |
| 23 | 12992 | 14648 | 17962 |
| 24 | 13014 | 14684 | 18056 |
| 25 | 13036 | 14720 | 18153 |
| 26 | 13059 | 14756 | 18252 |
| 27 | 13081 | 14793 | 18355 |
| 28 | 13104 | 14830 | 18461 |
| 29 | 13126 | 14868 | 18570 |
| 30 | 13149 | 14906 | 18683 |
| 31 | 13172 | 14944 | 18799 |
| 32 | 13195 | 14983 | 18920 |
| 33 | 13219 | 15022 | 19045 |
| 34 | 13242 | 15062 | 19174 |
| 35 | 13266 | 15102 | 19309 |
| 36 | 13290 | 15143 | 19450 |
| 37 | 13314 | 15184 | 19596 |
| 38 | 13338 | 15226 | 19749 |
| 39 | 13362 | 15268 | 19909 |
| 40 | 13386 | 15311 | 20076 |
| 41 | 13411 | 15354 | 20253 |
| 42 | 13436 | 15398 | 20439 |
| 43 | 13461 | 15442 | 20635 |
| 44 | 13486 | 15487 | 20844 |
| 45 | 13511 | 15532 | 21065 |
| 46 | 13537 | 15579 | 21303 |
| 47 | 13563 | 15625 | 21557 |
| 48 | 13589 | 15673 | 21833 |
| 49 | 13615 | 15721 | 22132 |
| 50 | 13641 | 15770 | 22459 |
| 51 | 13668 | 15819 | 22822 |
| 52 | 13695 | 15869 | 23226 |
| 53 | 13722 | 15920 | 23685 |
| 54 | 13749 | 15972 | 24215 |
| 55 | 13776 | 16024 | 24842 |
| 56 | 13804 | 16078 | 25609 |
| 57 | 13832 | 16132 | 26598 |
| 58 | 13860 | 16187 | 27992 |
| 59 | 13888 | 16243 | 30375 |
| M | 87° | 88° | 89° |

## TABLE III.*

CORRECTION OF THE MEAN REFRACTION.

| App. Alt. | Height of the Thermometer. 20° | 26° | 32° | 38° | 44° | 50° | 56° | 62° | 68° | 74° | 80° |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | +″ | +″ | +″ | +″ | +″ | ″ | −″ | −″ | −″ | −″ | −″ |
| 2 0 | 91 | 72 | 53 | 35 | 17 | 0 | 16 | 32 | 48 | 63 | 78 |
| 2 10 | 87 | 68 | 50 | 33 | 16 | 0 | 16 | 31 | 46 | 60 | 74 |
| 2 20 | 83 | 65 | 48 | 32 | 16 | 0 | 15 | 30 | 44 | 58 | 71 |
| 2 30 | 80 | 63 | 46 | 30 | 15 | 0 | 15 | 29 | 43 | 56 | 68 |
| 2 40 | 77 | 60 | 44 | 29 | 14 | 0 | 14 | 28 | 41 | 54 | 66 |
| 2 50 | 74 | 58 | 43 | 28 | 14 | 0 | 13 | 27 | 40 | 52 | 64 |
| 3 0 | 71 | 56 | 41 | 27 | 13 | 0 | 13 | 26 | 38 | 50 | 61 |
| 3 10 | 68 | 54 | 40 | 26 | 13 | 0 | 12 | 25 | 37 | 48 | 59 |
| 3 20 | 66 | 52 | 38 | 25 | 13 | 0 | 12 | 24 | 35 | 46 | 57 |
| 3 30 | 64 | 50 | 37 | 24 | 12 | 0 | 11 | 23 | 34 | 45 | 55 |
| 3 40 | 62 | 49 | 36 | 24 | 12 | 0 | 11 | 22 | 33 | 43 | 53 |
| 3 50 | 60 | 47 | 35 | 23 | 11 | 0 | 10 | 21 | 31 | 42 | 52 |
| 4 0 | 58 | 45 | 33 | 22 | 11 | 0 | 10 | 20 | 30 | 40 | 50 |
| 4 30 | 53 | 42 | 31 | 21 | 10 | 0 | 9 | 19 | 28 | 37 | 45 |
| 5 0 | 48 | 38 | 28 | 18 | 9 | 0 | 9 | 17 | 26 | 33 | 40 |
| 5 30 | 45 | 35 | 26 | 17 | 8 | 0 | 8 | 16 | 24 | 31 | 38 |
| 6 0 | 41 | 32 | 24 | 16 | 8 | 0 | 7 | 15 | 22 | 29 | 35 |
| 6 30 | 38 | 30 | 22 | 14 | 7 | 0 | 7 | 14 | 20 | 27 | 33 |
| 7 0 | 36 | 28 | 21 | 14 | 7 | 0 | 6 | 13 | 19 | 25 | 31 |
| 7 30 | 34 | 27 | 20 | 13 | 6 | 0 | 6 | 12 | 18 | 24 | 29 |
| 8 0 | 32 | 25 | 19 | 12 | 6 | 0 | 5 | 11 | 16 | 22 | 27 |
| 8 30 | 30 | 23 | 17 | 11 | 6 | 0 | 5 | 10 | 15 | 20 | 25 |
| 9 0 | 28 | 22 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 24 |
| 9 30 | 27 | 21 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 23 |
| 10 0 | 26 | 20 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 18 | 22 |
| 10 30 | 24 | 19 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 17 | 21 |
| 11 0 | 23 | 18 | 14 | 9 | 5 | 0 | 4 | 8 | 12 | 16 | 20 |
| 11 30 | 22 | 17 | 13 | 9 | 4 | 0 | 4 | 8 | 12 | 16 | 19 |
| 12 0 | 21 | 17 | 13 | 8 | 4 | 0 | 4 | 8 | 11 | 15 | 18 |
| 13 0 | 20 | 16 | 12 | 8 | 4 | 0 | 3 | 7 | 10 | 14 | 17 |
| 14 0 | 18 | 14 | 11 | 7 | 4 | 0 | 3 | 6 | 9 | 13 | 16 |
| 15 0 | 17 | 13 | 10 | 6 | 3 | 0 | 3 | 6 | 9 | 12 | 15 |
| 16 0 | 16 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 14 |
| 17 0 | 15 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 13 |
| 18 0 | 14 | 11 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 10 | 12 |
| 19 0 | 13 | 10 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 9 | 11 |
| 20 0 | 13 | 10 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 9 | 11 |
| 21 0 | 12 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 22 0 | 11 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 23 0 | 11 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 6 | 7 | 9 |
| 24 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 9 |
| 25 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 26 0 | 9 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 27 0 | 9 | 7 | 5 | 3 | 2 | 0 | 2 | 3 | 5 | 6 | 8 |
| 28 0 | 9 | 7 | 5 | 3 | 2 | 0 | 1 | 3 | 5 | 6 | 7 |
| 29 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 3 | 4 | 6 | 7 |
| 30 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 2 | 4 | 5 | 7 |
| 32 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 4 | 5 | 6 |
| 34 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 5 | 6 |
| 36 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 38 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 40 0 | 6 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 45 0 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 1 | 2 | 3 | 4 |
| 50 0 | 4 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 3 | 3 |
| 55 0 | 3 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 3 |
| 60 0 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| 65 0 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 70 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 80 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 90 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | − | − | − | | + | + | + | | |
| | | | 28.3 | 28.7 | 29.2 | 29.6 | 30.0 | 30.5 | 30.9 | | |

Height of the Barometer.

# TABLE III.

## MERIDIONAL PARTS.

| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6970 | 7210 | 7467 | 7745 | 8046 | 8375 | 8739 | 9145 | 9606 | 10137 | 10765 | 11533 | 0 |
| 1 | 6974 | 7214 | 7472 | 7749 | 8051 | 8381 | 8745 | 9153 | 9614 | 10147 | 10776 | 11547 | 1 |
| 2 | 6978 | 7218 | 7476 | 7754 | 8056 | 8387 | 8752 | 9160 | 9622 | 10156 | 10788 | 11561 | 2 |
| 3 | 6982 | 7222 | 7481 | 7759 | 8061 | 8393 | 8758 | 9167 | 9631 | 10166 | 10799 | 11576 | 3 |
| 4 | 6986 | 7227 | 7485 | 7764 | 8067 | 8398 | 8765 | 9174 | 9639 | 10175 | 10811 | 11590 | 4 |
| 5 | 6990 | 7231 | 7490 | 7769 | 8072 | 8404 | 8771 | 9182 | 9647 | 10185 | 10823 | 11605 | 5 |
| 6 | 6994 | 7235 | 7494 | 7774 | 8077 | 8410 | 8778 | 9189 | 9655 | 10195 | 10834 | 11620 | 6 |
| 7 | 6997 | 7239 | 7498 | 7778 | 8083 | 8416 | 8784 | 9196 | 9664 | 10205 | 10846 | 11634 | 7 |
| 8 | 7001 | 7243 | 7503 | 7783 | 8088 | 8422 | 8791 | 9203 | 9672 | 10214 | 10858 | 11649 | 8 |
| 9 | 7005 | 7247 | 7507 | 7788 | 8093 | 8427 | 8797 | 9211 | 9680 | 10224 | 10870 | 11664 | 9 |
| 10 | 7009 | 7252 | 7512 | 7793 | 8099 | 8433 | 8804 | 9218 | 9689 | 10234 | 10881 | 11679 | 10 |
| 11 | 7013 | 7256 | 7516 | 7798 | 8104 | 8439 | 8810 | 9225 | 9697 | 10244 | 10893 | 11694 | 11 |
| 12 | 7017 | 7260 | 7521 | 7803 | 8109 | 8445 | 8817 | 9233 | 9706 | 10254 | 10905 | 11709 | 12 |
| 13 | 7021 | 7264 | 7525 | 7808 | 8115 | 8451 | 8823 | 9240 | 9714 | 10264 | 10917 | 11724 | 13 |
| 14 | 7025 | 7268 | 7530 | 7813 | 8120 | 8457 | 8830 | 9248 | 9723 | 10274 | 10929 | 11739 | 14 |
| 15 | 7029 | 7273 | 7535 | 7817 | 8125 | 8463 | 8836 | 9255 | 9731 | 10284 | 10941 | 11755 | 15 |
| 16 | 7033 | 7277 | 7539 | 7822 | 8131 | 8469 | 8843 | 9262 | 9740 | 10294 | 10953 | 11770 | 16 |
| 17 | 7037 | 7281 | 7544 | 7827 | 8136 | 8474 | 8849 | 9270 | 9748 | 10304 | 10965 | 11785 | 17 |
| 18 | 7041 | 7285 | 7548 | 7832 | 8141 | 8480 | 8856 | 9277 | 9757 | 10314 | 10978 | 11801 | 18 |
| 19 | 7045 | 7289 | 7553 | 7837 | 8147 | 8486 | 8863 | 9285 | 9765 | 10324 | 10990 | 11816 | 19 |
| 20 | 7048 | 7294 | 7557 | 7842 | 8152 | 8492 | 8869 | 9292 | 9774 | 10334 | 11002 | 11832 | 20 |
| 21 | 7052 | 7298 | 7562 | 7847 | 8158 | 8498 | 8876 | 9300 | 9783 | 10344 | 11014 | 11848 | 21 |
| 22 | 7056 | 7302 | 7566 | 7852 | 8163 | 8504 | 8883 | 9307 | 9791 | 10354 | 11027 | 11863 | 22 |
| 23 | 7060 | 7306 | 7571 | 7857 | 8168 | 8510 | 8889 | 9315 | 9800 | 10364 | 11039 | 11879 | 23 |
| 24 | 7064 | 7311 | 7576 | 7862 | 8174 | 8516 | 8896 | 9322 | 9809 | 10374 | 11052 | 11895 | 24 |
| 25 | 7068 | 7315 | 7580 | 7867 | 8179 | 8522 | 8903 | 9330 | 9817 | 10385 | 11064 | 11911 | 25 |
| 26 | 7072 | 7319 | 7585 | 7872 | 8185 | 8528 | 8909 | 9337 | 9826 | 10395 | 11077 | 11927 | 26 |
| 27 | 7076 | 7323 | 7589 | 7877 | 8190 | 8534 | 8916 | 9345 | 9835 | 10405 | 11089 | 11943 | 27 |
| 28 | 7080 | 7328 | 7594 | 7882 | 8196 | 8540 | 8923 | 9353 | 9844 | 10416 | 11102 | 11959 | 28 |
| 29 | 7084 | 7332 | 7599 | 7887 | 8201 | 8546 | 8930 | 9360 | 9852 | 10426 | 11115 | 11976 | 29 |
| 30 | 7088 | 7336 | 7603 | 7892 | 8207 | 8552 | 8936 | 9368 | 9861 | 10437 | 11127 | 11992 | 30 |
| 31 | 7092 | 7341 | 7608 | 7897 | 8212 | 8558 | 8943 | 9376 | 9870 | 10447 | 11140 | 12008 | 31 |
| 32 | 7096 | 7345 | 7612 | 7902 | 8218 | 8565 | 8950 | 9383 | 9879 | 10457 | 11153 | 12025 | 32 |
| 33 | 7100 | 7349 | 7617 | 7907 | 8223 | 8571 | 8957 | 9391 | 9888 | 10468 | 11166 | 12041 | 33 |
| 34 | 7104 | 7353 | 7622 | 7912 | 8229 | 8577 | 8963 | 9399 | 9897 | 10478 | 11179 | 12058 | 34 |
| 35 | 7108 | 7358 | 7626 | 7917 | 8234 | 8583 | 8970 | 9407 | 9906 | 10489 | 11192 | 12075 | 35 |
| 36 | 7112 | 7362 | 7631 | 7922 | 8240 | 8589 | 8977 | 9415 | 9915 | 10500 | 11205 | 12092 | 36 |
| 37 | 7116 | 7366 | 7636 | 7927 | 8245 | 8595 | 8984 | 9422 | 9924 | 10510 | 11218 | 12109 | 37 |
| 38 | 7120 | 7371 | 7640 | 7932 | 8251 | 8601 | 8991 | 9430 | 9933 | 10521 | 11231 | 12126 | 38 |
| 39 | 7124 | 7375 | 7645 | 7937 | 8256 | 8607 | 8998 | 9437 | 9942 | 10532 | 11244 | 12143 | 39 |
| 40 | 7128 | 7379 | 7650 | 7942 | 8262 | 8614 | 9005 | 9445 | 9951 | 10542 | 11257 | 12160 | 40 |
| 41 | 7132 | 7384 | 7654 | 7948 | 8267 | 8620 | 9012 | 9453 | 9960 | 10553 | 11270 | 12177 | 41 |
| 42 | 7136 | 7388 | 7659 | 7953 | 8273 | 8626 | 9018 | 9461 | 9969 | 10564 | 11284 | 12194 | 42 |
| 43 | 7140 | 7392 | 7664 | 7958 | 8279 | 8632 | 9025 | 9469 | 9978 | 10575 | 11297 | 12212 | 43 |
| 44 | 7145 | 7397 | 7668 | 7963 | 8284 | 8638 | 9032 | 9477 | 9987 | 10586 | 11310 | 12229 | 44 |
| 45 | 7149 | 7401 | 7673 | 7968 | 8290 | 8644 | 9039 | 9485 | 9996 | 10597 | 11324 | 12247 | 45 |
| 46 | 7153 | 7406 | 7678 | 7973 | 8295 | 8651 | 9046 | 9493 | 10005 | 10608 | 11338 | 12265 | 46 |
| 47 | 7157 | 7410 | 7683 | 7978 | 8301 | 8657 | 9053 | 9501 | 10015 | 10619 | 11351 | 12282 | 47 |
| 48 | 7161 | 7414 | 7687 | 7983 | 8307 | 8663 | 9060 | 9509 | 10024 | 10630 | 11365 | 12300 | 48 |
| 49 | 7165 | 7419 | 7692 | 7989 | 8312 | 8669 | 9067 | 9517 | 10033 | 10641 | 11378 | 12318 | 49 |
| 50 | 7169 | 7423 | 7697 | 7994 | 8318 | 8676 | 9074 | 9525 | 10043 | 10652 | 11392 | 12336 | 50 |
| 51 | 7173 | 7427 | 7702 | 7999 | 8324 | 8682 | 9081 | 9533 | 10052 | 10663 | 11406 | 12354 | 51 |
| 52 | 7177 | 7432 | 7706 | 8004 | 8329 | 8688 | 9088 | 9541 | 10061 | 10674 | 11420 | 12373 | 52 |
| 53 | 7181 | 7436 | 7711 | 8009 | 8335 | 8695 | 9096 | 9549 | 10071 | 10685 | 11434 | 12391 | 53 |
| 54 | 7185 | 7441 | 7716 | 8014 | 8341 | 8701 | 9103 | 9557 | 10080 | 10696 | 11448 | 12409 | 54 |
| 55 | 7189 | 7445 | 7721 | 8020 | 8347 | 8707 | 9110 | 9565 | 10089 | 10708 | 11462 | 12428 | 55 |
| 56 | 7194 | 7449 | 7725 | 8025 | 8352 | 8714 | 9117 | 9573 | 10099 | 10719 | 11476 | 12446 | 56 |
| 57 | 7198 | 7454 | 7730 | 8030 | 8358 | 8720 | 9124 | 9581 | 10108 | 10730 | 11490 | 12465 | 57 |
| 58 | 7202 | 7458 | 7735 | 8035 | 8364 | 8726 | 9131 | 9589 | 10118 | 10742 | 11504 | 12484 | 58 |
| 59 | 7206 | 7463 | 7740 | 8040 | 8369 | 8733 | 9138 | 9598 | 10127 | 10753 | 11518 | 12503 | 59 |
| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |

## TABLE III

MERIDIONAL PARTS.

| M | 87° | 88° | 89° |
|---|---|---|---|
| 0 | 12522 | 13916 | 16300 |
| 1 | 12541 | 13945 | 16357 |
| 2 | 12561 | 13974 | 16416 |
| 3 | 12580 | 14004 | 16476 |
| 4 | 12599 | 14033 | 16537 |
| 5 | 12619 | 14063 | 16599 |
| 6 | 12639 | 14093 | 16662 |
| 7 | 12659 | 14123 | 16726 |
| 8 | 12679 | 14154 | 16792 |
| 9 | 12699 | 14185 | 16858 |
| 10 | 12719 | 14216 | 16926 |
| 11 | 12739 | 14247 | 16996 |
| 12 | 12759 | 14279 | 17067 |
| 13 | 12780 | 14311 | 17139 |
| 14 | 12801 | 14343 | 17213 |
| 15 | 12821 | 14376 | 17289 |
| 16 | 12842 | 14409 | 17366 |
| 17 | 12863 | 14442 | 17445 |
| 18 | 12885 | 14475 | 17526 |
| 19 | 12906 | 14509 | 17609 |
| 20 | 12927 | 14543 | 17691 |
| 21 | 12949 | 14578 | 17781 |
| 22 | 12970 | 14613 | 17870 |
| 23 | 12992 | 14648 | 17962 |
| 24 | 13014 | 14684 | 18056 |
| 25 | 13036 | 14720 | 18153 |
| 26 | 13059 | 14756 | 18252 |
| 27 | 13081 | 14793 | 18355 |
| 28 | 13104 | 14830 | 18461 |
| 29 | 13126 | 14868 | 18570 |
| 30 | 13149 | 14906 | 18683 |
| 31 | 13172 | 14944 | 18799 |
| 32 | 13195 | 14983 | 18920 |
| 33 | 13219 | 15022 | 19045 |
| 34 | 13242 | 15062 | 19174 |
| 35 | 13266 | 15102 | 19309 |
| 36 | 13290 | 15143 | 19450 |
| 37 | 13314 | 15184 | 19596 |
| 38 | 13338 | 15226 | 19749 |
| 39 | 13362 | 15268 | 19909 |
| 40 | 13386 | 15311 | 20076 |
| 41 | 13411 | 15354 | 20253 |
| 42 | 13436 | 15398 | 20439 |
| 43 | 13461 | 15442 | 20635 |
| 44 | 13486 | 15487 | 20844 |
| 45 | 13511 | 15532 | 21065 |
| 46 | 13537 | 15579 | 21303 |
| 47 | 13563 | 15625 | 21557 |
| 48 | 13589 | 15673 | 21833 |
| 49 | 13615 | 15721 | 22132 |
| 50 | 13641 | 15770 | 22459 |
| 51 | 13668 | 15819 | 22822 |
| 52 | 13695 | 15869 | 23226 |
| 53 | 13722 | 15920 | 23685 |
| 54 | 13749 | 15972 | 24215 |
| 55 | 13776 | 16024 | 24842 |
| 56 | 13804 | 16078 | 25609 |
| 57 | 13832 | 16132 | 26598 |
| 58 | 13860 | 16187 | 27992 |
| 59 | 13888 | 16243 | 30375 |
| M | 87° | 88° | 89° |

## TABLE III.*

CORRECTION OF THE MEAN REFRACTION.

| App. Alt. | Height of the Thermometer. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 20° | 26° | 32° | 38° | 44° | 50° | 56° | 62° | 68° | 74° | 80° |
| ° ′ | +″ | +″ | +″ | +″ | +″ | ″ | −″ | −″ | −″ | −″ | −″ |
| 2 0 | 91 | 72 | 53 | 35 | 17 | 0 | 16 | 32 | 48 | 63 | 78 |
| 2 10 | 87 | 68 | 50 | 33 | 16 | 0 | 16 | 31 | 46 | 60 | 74 |
| 2 20 | 83 | 65 | 48 | 32 | 16 | 0 | 15 | 30 | 44 | 58 | 71 |
| 2 30 | 80 | 63 | 46 | 30 | 15 | 0 | 15 | 29 | 43 | 56 | 68 |
| 2 40 | 77 | 60 | 44 | 29 | 14 | 0 | 14 | 28 | 41 | 54 | 66 |
| 2 50 | 74 | 58 | 43 | 28 | 14 | 0 | 13 | 27 | 40 | 52 | 64 |
| 3 0 | 71 | 56 | 41 | 27 | 13 | 0 | 13 | 26 | 38 | 50 | 61 |
| 3 10 | 68 | 54 | 40 | 26 | 13 | 0 | 12 | 25 | 37 | 48 | 59 |
| 3 20 | 66 | 52 | 38 | 25 | 13 | 0 | 12 | 24 | 35 | 46 | 57 |
| 3 30 | 64 | 50 | 37 | 24 | 12 | 0 | 11 | 23 | 34 | 45 | 55 |
| 3 40 | 62 | 49 | 36 | 24 | 12 | 0 | 11 | 22 | 33 | 43 | 53 |
| 3 50 | 60 | 47 | 35 | 23 | 11 | 0 | 10 | 21 | 31 | 42 | 52 |
| 4 0 | 58 | 45 | 33 | 22 | 11 | 0 | 10 | 20 | 30 | 40 | 50 |
| 4 30 | 53 | 42 | 31 | 21 | 10 | 0 | 9 | 19 | 28 | 37 | 45 |
| 5 0 | 48 | 38 | 28 | 18 | 9 | 0 | 9 | 17 | 26 | 33 | 40 |
| 5 30 | 45 | 35 | 26 | 17 | 8 | 0 | 8 | 16 | 24 | 31 | 38 |
| 6 0 | 41 | 32 | 24 | 16 | 8 | 0 | 7 | 15 | 22 | 29 | 35 |
| 6 30 | 38 | 30 | 22 | 14 | 7 | 0 | 7 | 14 | 20 | 27 | 33 |
| 7 0 | 36 | 28 | 21 | 14 | 7 | 0 | 6 | 13 | 19 | 25 | 31 |
| 7 30 | 34 | 27 | 20 | 13 | 6 | 0 | 6 | 12 | 18 | 24 | 29 |
| 8 0 | 32 | 25 | 19 | 12 | 6 | 0 | 5 | 11 | 16 | 22 | 27 |
| 8 30 | 30 | 23 | 17 | 11 | 6 | 0 | 5 | 10 | 15 | 20 | 25 |
| 9 0 | 28 | 22 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 24 |
| 9 30 | 27 | 21 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 23 |
| 10 0 | 26 | 20 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 18 | 22 |
| 10 30 | 24 | 19 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 17 | 21 |
| 11 0 | 23 | 18 | 14 | 9 | 5 | 0 | 4 | 8 | 12 | 16 | 20 |
| 11 30 | 22 | 17 | 13 | 9 | 4 | 0 | 4 | 8 | 12 | 16 | 19 |
| 12 0 | 21 | 17 | 13 | 8 | 4 | 0 | 4 | 8 | 11 | 15 | 18 |
| 13 0 | 20 | 16 | 12 | 8 | 4 | 0 | 3 | 7 | 10 | 14 | 17 |
| 14 0 | 18 | 14 | 11 | 7 | 4 | 0 | 3 | 6 | 9 | 13 | 16 |
| 15 0 | 17 | 13 | 10 | 6 | 3 | 0 | 3 | 6 | 9 | 12 | 15 |
| 16 0 | 16 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 14 |
| 17 0 | 15 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 13 |
| 18 0 | 14 | 11 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 10 | 12 |
| 19 0 | 13 | 10 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 9 | 11 |
| 20 0 | 13 | 10 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 9 | 11 |
| 21 0 | 12 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 22 0 | 11 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 23 0 | 11 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 6 | 7 | 9 |
| 24 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 9 |
| 25 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 26 0 | 9 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 27 0 | 9 | 7 | 5 | 3 | 2 | 0 | 2 | 3 | 5 | 6 | 8 |
| 28 0 | 9 | 7 | 5 | 3 | 2 | 0 | 1 | 3 | 5 | 6 | 7 |
| 29 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 3 | 4 | 6 | 7 |
| 30 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 2 | 4 | 5 | 7 |
| 32 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 4 | 5 | 6 |
| 34 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 5 | 6 |
| 36 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 38 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 40 0 | 6 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 45 0 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 1 | 2 | 3 | 4 |
| 50 0 | 4 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 3 | 3 |
| 55 0 | 3 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 3 |
| 60 0 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| 65 0 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 70 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 80 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 90 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | − | − | − | | + | + | + | | |
| | | | 28.3 | 28.7 | 29.2 | 29.6 | 30.0 | 30.5 | 30.9 | | |

Height of the Barometer.

# TABLE III.

## MERIDIONAL PARTS.

| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6970 | 7210 | 7467 | 7745 | 8046 | 8375 | 8739 | 9145 | 9606 | 10137 | 10765 | 11533 | 0 |
| 1 | 6974 | 7214 | 7472 | 7749 | 8051 | 8381 | 8745 | 9153 | 9614 | 10147 | 10776 | 11547 | 1 |
| 2 | 6978 | 7218 | 7476 | 7754 | 8056 | 8387 | 8752 | 9160 | 9622 | 10156 | 10788 | 11561 | 2 |
| 3 | 6982 | 7222 | 7481 | 7759 | 8061 | 8393 | 8758 | 9167 | 9631 | 10166 | 10799 | 11576 | 3 |
| 4 | 6986 | 7227 | 7485 | 7764 | 8067 | 8398 | 8765 | 9174 | 9639 | 10175 | 10811 | 11590 | 4 |
| 5 | 6990 | 7231 | 7490 | 7769 | 8072 | 8404 | 8771 | 9182 | 9647 | 10185 | 10823 | 11605 | 5 |
| 6 | 6994 | 7235 | 7494 | 7774 | 8077 | 8410 | 8778 | 9189 | 9655 | 10195 | 10834 | 11620 | 6 |
| 7 | 6997 | 7239 | 7498 | 7778 | 8083 | 8416 | 8784 | 9196 | 9664 | 10205 | 10846 | 11634 | 7 |
| 8 | 7001 | 7243 | 7503 | 7783 | 8088 | 8422 | 8791 | 9203 | 9672 | 10214 | 10858 | 11649 | 8 |
| 9 | 7005 | 7247 | 7507 | 7788 | 8093 | 8427 | 8797 | 9211 | 9680 | 10224 | 10870 | 11664 | 9 |
| 10 | 7009 | 7252 | 7512 | 7793 | 8099 | 8433 | 8804 | 9218 | 9689 | 10234 | 10881 | 11679 | 10 |
| 11 | 7013 | 7256 | 7516 | 7798 | 8104 | 8439 | 8810 | 9225 | 9697 | 10244 | 10893 | 11694 | 11 |
| 12 | 7017 | 7260 | 7521 | 7803 | 8109 | 8445 | 8817 | 9233 | 9706 | 10254 | 10905 | 11709 | 12 |
| 13 | 7021 | 7264 | 7525 | 7808 | 8115 | 8451 | 8823 | 9240 | 9714 | 10264 | 10917 | 11724 | 13 |
| 14 | 7025 | 7268 | 7530 | 7813 | 8120 | 8457 | 8830 | 9248 | 9723 | 10274 | 10929 | 11739 | 14 |
| 15 | 7029 | 7273 | 7535 | 7817 | 8125 | 8463 | 8836 | 9255 | 9731 | 10284 | 10941 | 11755 | 15 |
| 16 | 7033 | 7277 | 7539 | 7822 | 8131 | 8469 | 8843 | 9262 | 9740 | 10294 | 10953 | 11770 | 16 |
| 17 | 7037 | 7281 | 7544 | 7827 | 8136 | 8474 | 8849 | 9270 | 9748 | 10304 | 10965 | 11785 | 17 |
| 18 | 7041 | 7285 | 7548 | 7832 | 8141 | 8480 | 8856 | 9277 | 9757 | 10314 | 10978 | 11801 | 18 |
| 19 | 7045 | 7289 | 7553 | 7837 | 8147 | 8486 | 8863 | 9285 | 9765 | 10324 | 10990 | 11816 | 19 |
| 20 | 7048 | 7294 | 7557 | 7842 | 8152 | 8492 | 8869 | 9292 | 9774 | 10334 | 11002 | 11832 | 20 |
| 21 | 7052 | 7298 | 7562 | 7847 | 8158 | 8498 | 8876 | 9300 | 9783 | 10344 | 11014 | 11848 | 21 |
| 22 | 7056 | 7302 | 7566 | 7852 | 8163 | 8504 | 8883 | 9307 | 9791 | 10354 | 11027 | 11863 | 22 |
| 23 | 7060 | 7306 | 7571 | 7857 | 8168 | 8510 | 8889 | 9315 | 9800 | 10364 | 11039 | 11879 | 23 |
| 24 | 7064 | 7311 | 7576 | 7862 | 8174 | 8516 | 8896 | 9322 | 9809 | 10374 | 11052 | 11895 | 24 |
| 25 | 7068 | 7315 | 7580 | 7867 | 8179 | 8522 | 8903 | 9330 | 9817 | 10385 | 11064 | 11911 | 25 |
| 26 | 7072 | 7319 | 7585 | 7872 | 8185 | 8528 | 8909 | 9337 | 9826 | 10395 | 11077 | 11927 | 26 |
| 27 | 7076 | 7323 | 7589 | 7877 | 8190 | 8534 | 8916 | 9345 | 9835 | 10405 | 11089 | 11943 | 27 |
| 28 | 7080 | 7328 | 7594 | 7882 | 8196 | 8540 | 8923 | 9353 | 9844 | 10416 | 11102 | 11959 | 28 |
| 29 | 7084 | 7332 | 7599 | 7887 | 8201 | 8546 | 8930 | 9360 | 9852 | 10426 | 11115 | 11976 | 29 |
| 30 | 7088 | 7336 | 7603 | 7892 | 8207 | 8552 | 8936 | 9368 | 9861 | 10437 | 11127 | 11992 | 30 |
| 31 | 7092 | 7341 | 7608 | 7897 | 8212 | 8558 | 8943 | 9376 | 9870 | 10447 | 11140 | 12008 | 31 |
| 32 | 7096 | 7345 | 7612 | 7902 | 8218 | 8565 | 8950 | 9383 | 9879 | 10457 | 11153 | 12025 | 32 |
| 33 | 7100 | 7349 | 7617 | 7907 | 8223 | 8571 | 8957 | 9391 | 9888 | 10468 | 11166 | 12041 | 33 |
| 34 | 7104 | 7353 | 7622 | 7912 | 8229 | 8577 | 8963 | 9399 | 9897 | 10478 | 11179 | 12058 | 34 |
| 35 | 7108 | 7358 | 7626 | 7917 | 8234 | 8583 | 8970 | 9407 | 9906 | 10489 | 11192 | 12075 | 35 |
| 36 | 7112 | 7362 | 7631 | 7922 | 8240 | 8589 | 8977 | 9415 | 9915 | 10500 | 11205 | 12092 | 36 |
| 37 | 7116 | 7366 | 7636 | 7927 | 8245 | 8595 | 8984 | 9422 | 9924 | 10510 | 11218 | 12109 | 37 |
| 38 | 7120 | 7371 | 7640 | 7932 | 8251 | 8601 | 8991 | 9430 | 9933 | 10521 | 11231 | 12126 | 38 |
| 39 | 7124 | 7375 | 7645 | 7937 | 8256 | 8607 | 8998 | 9437 | 9942 | 10532 | 11244 | 12143 | 39 |
| 40 | 7128 | 7379 | 7650 | 7942 | 8262 | 8614 | 9005 | 9445 | 9951 | 10542 | 11257 | 12160 | 40 |
| 41 | 7132 | 7384 | 7654 | 7948 | 8267 | 8620 | 9012 | 9453 | 9960 | 10553 | 11270 | 12177 | 41 |
| 42 | 7136 | 7388 | 7659 | 7953 | 8273 | 8626 | 9018 | 9461 | 9969 | 10564 | 11284 | 12194 | 42 |
| 43 | 7140 | 7392 | 7664 | 7958 | 8279 | 8632 | 9025 | 9469 | 9978 | 10575 | 11297 | 12212 | 43 |
| 44 | 7145 | 7397 | 7668 | 7963 | 8284 | 8638 | 9032 | 9477 | 9987 | 10586 | 11310 | 12229 | 44 |
| 45 | 7149 | 7401 | 7673 | 7968 | 8290 | 8644 | 9039 | 9485 | 9996 | 10597 | 11324 | 12247 | 45 |
| 46 | 7153 | 7406 | 7678 | 7973 | 8295 | 8651 | 9046 | 9493 | 10005 | 10608 | 11338 | 12265 | 46 |
| 47 | 7157 | 7410 | 7683 | 7978 | 8301 | 8657 | 9053 | 9501 | 10015 | 10619 | 11351 | 12282 | 47 |
| 48 | 7161 | 7414 | 7687 | 7983 | 8307 | 8663 | 9060 | 9509 | 10024 | 10630 | 11365 | 12300 | 48 |
| 49 | 7165 | 7419 | 7692 | 7989 | 8312 | 8669 | 9067 | 9517 | 10033 | 10641 | 11378 | 12318 | 49 |
| 50 | 7169 | 7423 | 7697 | 7994 | 8318 | 8676 | 9074 | 9525 | 10043 | 10652 | 11392 | 12336 | 50 |
| 51 | 7173 | 7427 | 7702 | 7999 | 8324 | 8682 | 9081 | 9533 | 10052 | 10663 | 11406 | 12354 | 51 |
| 52 | 7177 | 7432 | 7706 | 8004 | 8329 | 8688 | 9088 | 9541 | 10061 | 10674 | 11420 | 12373 | 52 |
| 53 | 7181 | 7436 | 7711 | 8009 | 8335 | 8695 | 9096 | 9549 | 10071 | 10685 | 11434 | 12391 | 53 |
| 54 | 7185 | 7441 | 7716 | 8014 | 8341 | 8701 | 9103 | 9557 | 10080 | 10696 | 11448 | 12409 | 54 |
| 55 | 7189 | 7445 | 7721 | 8020 | 8347 | 8707 | 9110 | 9565 | 10089 | 10708 | 11462 | 12428 | 55 |
| 56 | 7194 | 7449 | 7725 | 8025 | 8352 | 8714 | 9117 | 9573 | 10099 | 10719 | 11476 | 12440 | 56 |
| 57 | 7198 | 7454 | 7730 | 8030 | 8358 | 8720 | 9124 | 9581 | 10108 | 10730 | 11490 | 12465 | 57 |
| 58 | 7202 | 7458 | 7735 | 8035 | 8364 | 8726 | 9131 | 9589 | 10118 | 10742 | 11504 | 12484 | 58 |
| 59 | 7206 | 7463 | 7740 | 8040 | 8369 | 8733 | 9138 | 9598 | 10127 | 10753 | 11518 | 12503 | 59 |
| M | 75° | 76° | 77° | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | M |

## TABLE III

MERIDIONAL PARTS.

| M | 87° | 88° | 89° |
|---|---|---|---|
| 0 | 12522 | 13916 | 16300 |
| 1 | 12541 | 13945 | 16357 |
| 2 | 12561 | 13974 | 16416 |
| 3 | 12580 | 14004 | 16476 |
| 4 | 12599 | 14033 | 16537 |
| 5 | 12619 | 14063 | 16599 |
| 6 | 12639 | 14093 | 16662 |
| 7 | 12659 | 14123 | 16726 |
| 8 | 12679 | 14154 | 16792 |
| 9 | 12699 | 14185 | 16858 |
| 10 | 12719 | 14216 | 16926 |
| 11 | 12739 | 14247 | 16996 |
| 12 | 12759 | 14279 | 17067 |
| 13 | 12780 | 14311 | 17139 |
| 14 | 12801 | 14343 | 17213 |
| 15 | 12821 | 14376 | 17289 |
| 16 | 12842 | 14409 | 17366 |
| 17 | 12863 | 14442 | 17445 |
| 18 | 12885 | 14476 | 17526 |
| 19 | 12906 | 14509 | 17609 |
| 20 | 12927 | 14543 | 17694 |
| 21 | 12949 | 14578 | 17781 |
| 22 | 12970 | 14613 | 17870 |
| 23 | 12992 | 14648 | 17962 |
| 24 | 13014 | 14684 | 18056 |
| 25 | 13036 | 14720 | 18153 |
| 26 | 13059 | 14756 | 18252 |
| 27 | 13081 | 14793 | 18355 |
| 28 | 13104 | 14830 | 18461 |
| 29 | 13126 | 14868 | 18570 |
| 30 | 13149 | 14906 | 18683 |
| 31 | 13172 | 14944 | 18799 |
| 32 | 13195 | 14983 | 18920 |
| 33 | 13219 | 15022 | 19045 |
| 34 | 13242 | 15062 | 19174 |
| 35 | 13266 | 15102 | 19309 |
| 36 | 13290 | 15143 | 19450 |
| 37 | 13314 | 15184 | 19596 |
| 38 | 13338 | 15226 | 19749 |
| 39 | 13362 | 15268 | 19909 |
| 40 | 13386 | 15311 | 20076 |
| 41 | 13411 | 15354 | 20253 |
| 42 | 13436 | 15398 | 20439 |
| 43 | 13461 | 15442 | 20635 |
| 44 | 13486 | 15487 | 20844 |
| 45 | 13511 | 15532 | 21065 |
| 46 | 13537 | 15579 | 21303 |
| 47 | 13563 | 15625 | 21557 |
| 48 | 13589 | 15673 | 21833 |
| 49 | 13615 | 15721 | 22132 |
| 50 | 13641 | 15770 | 22459 |
| 51 | 13668 | 15819 | 22822 |
| 52 | 13695 | 15869 | 23226 |
| 53 | 13722 | 15920 | 23685 |
| 54 | 13749 | 15972 | 24215 |
| 55 | 13776 | 16024 | 24842 |
| 56 | 13804 | 16078 | 25609 |
| 57 | 13832 | 16132 | 26598 |
| 58 | 13860 | 16187 | 27992 |
| 59 | 13888 | 16243 | 30375 |
| M | 87° | 88° | 89° |

## TABLE III.*

CORRECTION OF THE MEAN REFRACTION.

| App. Alt. | Height of the Thermometer. 20° | 26° | 32° | 38° | 44° | 50° | 56° | 62° | 68° | 74° | 80° |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | +″ | +″ | +″ | +″ | +″ | ″ | −″ | −″ | −″ | −″ | −″ |
| 2 0 | 91 | 72 | 53 | 35 | 17 | 0 | 16 | 32 | 48 | 63 | 78 |
| 2 10 | 87 | 68 | 50 | 33 | 16 | 0 | 16 | 31 | 46 | 60 | 74 |
| 2 20 | 83 | 65 | 48 | 32 | 16 | 0 | 15 | 30 | 44 | 58 | 71 |
| 2 30 | 80 | 63 | 46 | 30 | 15 | 0 | 15 | 29 | 43 | 56 | 68 |
| 2 40 | 77 | 60 | 44 | 29 | 14 | 0 | 14 | 28 | 41 | 54 | 66 |
| 2 50 | 74 | 58 | 43 | 28 | 14 | 0 | 13 | 27 | 40 | 52 | 64 |
| 3 0 | 71 | 56 | 41 | 27 | 13 | 0 | 13 | 26 | 38 | 50 | 61 |
| 3 10 | 68 | 54 | 40 | 26 | 13 | 0 | 12 | 25 | 37 | 48 | 59 |
| 3 20 | 66 | 52 | 38 | 25 | 13 | 0 | 12 | 24 | 35 | 46 | 57 |
| 3 30 | 64 | 50 | 37 | 24 | 12 | 0 | 11 | 23 | 34 | 45 | 55 |
| 3 40 | 62 | 49 | 36 | 24 | 12 | 0 | 11 | 22 | 33 | 43 | 53 |
| 3 50 | 60 | 47 | 35 | 23 | 11 | 0 | 10 | 21 | 31 | 42 | 52 |
| 4 0 | 58 | 45 | 33 | 22 | 11 | 0 | 10 | 20 | 30 | 40 | 50 |
| 4 30 | 53 | 42 | 31 | 21 | 10 | 0 | 9 | 19 | 28 | 37 | 45 |
| 5 0 | 48 | 38 | 28 | 18 | 9 | 0 | 9 | 17 | 26 | 33 | 40 |
| 5 30 | 45 | 35 | 26 | 17 | 8 | 0 | 8 | 16 | 24 | 31 | 38 |
| 6 0 | 41 | 32 | 24 | 16 | 8 | 0 | 7 | 15 | 22 | 29 | 35 |
| 6 30 | 38 | 30 | 22 | 14 | 7 | 0 | 7 | 14 | 20 | 27 | 33 |
| 7 0 | 36 | 28 | 21 | 14 | 7 | 0 | 6 | 13 | 19 | 25 | 31 |
| 7 30 | 34 | 27 | 20 | 13 | 6 | 0 | 6 | 12 | 18 | 24 | 29 |
| 8 0 | 32 | 25 | 19 | 12 | 6 | 0 | 5 | 11 | 16 | 22 | 27 |
| 8 30 | 30 | 23 | 17 | 11 | 6 | 0 | 5 | 10 | 15 | 20 | 25 |
| 9 0 | 28 | 22 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 24 |
| 9 30 | 27 | 21 | 16 | 10 | 5 | 0 | 5 | 10 | 14 | 19 | 23 |
| 10 0 | 26 | 20 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 18 | 22 |
| 10 30 | 24 | 19 | 15 | 10 | 5 | 0 | 4 | 9 | 13 | 17 | 21 |
| 11 0 | 23 | 18 | 14 | 9 | 5 | 0 | 4 | 8 | 12 | 16 | 20 |
| 11 30 | 22 | 17 | 13 | 9 | 4 | 0 | 4 | 8 | 12 | 16 | 19 |
| 12 0 | 21 | 17 | 13 | 8 | 4 | 0 | 4 | 8 | 11 | 15 | 18 |
| 13 0 | 20 | 16 | 12 | 8 | 4 | 0 | 3 | 7 | 10 | 14 | 17 |
| 14 0 | 18 | 14 | 11 | 7 | 4 | 0 | 3 | 6 | 9 | 13 | 16 |
| 15 0 | 17 | 13 | 10 | 6 | 3 | 0 | 3 | 6 | 9 | 12 | 15 |
| 16 0 | 16 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 14 |
| 17 0 | 15 | 12 | 9 | 6 | 3 | 0 | 3 | 6 | 8 | 11 | 13 |
| 18 0 | 14 | 11 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 10 | 12 |
| 19 0 | 13 | 10 | 8 | 5 | 3 | 0 | 2 | 5 | 7 | 9 | 11 |
| 20 0 | 13 | 10 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 9 | 11 |
| 21 0 | 12 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 22 0 | 11 | 9 | 7 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 23 0 | 11 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 6 | 7 | 9 |
| 24 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 9 |
| 25 0 | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 26 0 | 9 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 5 | 7 | 8 |
| 27 0 | 9 | 7 | 5 | 3 | 2 | 0 | 2 | 3 | 5 | 6 | 8 |
| 28 0 | 9 | 7 | 5 | 3 | 2 | 0 | 1 | 3 | 5 | 6 | 7 |
| 29 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 3 | 4 | 6 | 7 |
| 30 0 | 8 | 6 | 5 | 3 | 2 | 0 | 1 | 2 | 4 | 5 | 7 |
| 32 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 4 | 5 | 6 |
| 34 0 | 7 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 5 | 6 |
| 36 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 38 0 | 6 | 5 | 4 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 40 0 | 6 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 45 0 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 1 | 2 | 3 | 4 |
| 50 0 | 4 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 3 | 3 |
| 55 0 | 3 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 3 |
| 60 0 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| 65 0 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 70 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 80 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 90 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | − | − | − | | + | + | + | | |
| | | | 28,3 | 28.7 | 29.2 | 29.6 | 30.0 | 30,5 | 30.9 | | |

Height of the Barometer.

# TABLE IV.

## MEAN REFRACTION.

| App. Alt. | Refr. | App. Alt. | Refr. | App. Alt. | Refr. | App. Alt. | Refr. | App. Alt. | Refr. |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ |
| 0 0 | 33 0 | 5 0 | 9 54 | 10 0 | 5 15 | 20 0 | 2 35 | 34 0 | 1 24 |
| 0 5 | 32 10 | 5 5 | 9 46 | 10 10 | 5 10 | 20 10 | 2 34 | 34 30 | 1 23 |
| 0 10 | 31 22 | 5 10 | 9 38 | 10 20 | 5 5 | 20 20 | 2 32 | 35 0 | 1 21 |
| 0 15 | 30 35 | 5 15 | 9 30 | 10 30 | 5 0 | 20 30 | 2 31 | 35 30 | 1 20 |
| 0 20 | 29 50 | 5 20 | 9 23 | 10 40 | 4 56 | 20 40 | 2 29 | 36 0 | 1 18 |
| 0 25 | 29 6 | 5 25 | 9 15 | 10 50 | 4 51 | 20 50 | 2 28 | 36 30 | 1 17 |
| 0 30 | 28 23 | 5 30 | 9 8 | 11 0 | 4 47 | 21 0 | 2 27 | 37 0 | 1 16 |
| 0 35 | 27 41 | 5 35 | 9 1 | 11 10 | 4 43 | 21 10 | 2 26 | 37 30 | 1 14 |
| 0 40 | 27 0 | 5 40 | 8 54 | 11 20 | 4 39 | 21 20 | 2 25 | 38 0 | 1 13 |
| 0 45 | 26 20 | 5 45 | 8 47 | 11 30 | 4 34 | 21 30 | 2 24 | 38 30 | 1 11 |
| 0 50 | 25 42 | 5 50 | 8 41 | 11 40 | 4 31 | 21 40 | 2 23 | 39 0 | 1 10 |
| 0 55 | 25 5 | 5 55 | 8 34 | 11 50 | 4 27 | 21 50 | 2 21 | 39 30 | 1 9 |
| 1 0 | 24 29 | 6 0 | 8 28 | 12 0 | 4 23 | 22 0 | 2 20 | 40 0 | 1 8 |
| 1 5 | 23 54 | 6 5 | 8 21 | 12 10 | 4 20 | 22 10 | 2 19 | 41 0 | 1 5 |
| 1 10 | 23 20 | 6 10 | 8 15 | 12 20 | 4 16 | 22 20 | 2 18 | 42 0 | 1 3 |
| 1 15 | 22 47 | 6 15 | 8 9 | 12 30 | 4 13 | 22 30 | 2 17 | 43 0 | 1 1 |
| 1 20 | 22 15 | 6 20 | 8 3 | 12 40 | 4 9 | 22 40 | 2 16 | 44 0 | 0 59 |
| 1 25 | 21 44 | 6 25 | 7 57 | 12 50 | 4 6 | 22 50 | 2 15 | 45 0 | 0 57 |
| 1 30 | 21 15 | 6 30 | 7 51 | 13 0 | 4 3 | 23 0 | 2 14 | 46 0 | 0 55 |
| 1 35 | 20 46 | 6 35 | 7 45 | 13 10 | 4 0 | 23 10 | 2 13 | 47 0 | 0 53 |
| 1 40 | 20 18 | 6 40 | 7 40 | 13 20 | 3 57 | 23 20 | 2 12 | 48 0 | 0 51 |
| 1 45 | 19 51 | 6 45 | 7 35 | 13 30 | 3 54 | 23 30 | 2 11 | 49 0 | 0 49 |
| 1 50 | 19 25 | 6 50 | 7 30 | 13 40 | 3 51 | 23 40 | 2 10 | 50 0 | 0 48 |
| 1 55 | 19 0 | 6 55 | 7 25 | 13 50 | 3 48 | 23 50 | 2 9 | 51 0 | 0 46 |
| 2 0 | 18 35 | 7 0 | 7 20 | 14 0 | 3 45 | 24 0 | 2 8 | 52 0 | 0 44 |
| 2 5 | 18 11 | 7 5 | 7 15 | 14 10 | 3 43 | 24 10 | 2 7 | 53 0 | 0 43 |
| 2 10 | 17 48 | 7 10 | 7 11 | 14 20 | 3 40 | 24 20 | 2 6 | 54 0 | 0 41 |
| 2 15 | 17 26 | 7 15 | 7 6 | 14 30 | 3 38 | 24 30 | 2 5 | 55 0 | 0 40 |
| 2 20 | 17 4 | 7 20 | 7 2 | 14 40 | 3 35 | 24 40 | 2 4 | 56 0 | 0 38 |
| 2 25 | 16 44 | 7 25 | 6 57 | 14 50 | 3 33 | 24 50 | 2 3 | 57 0 | 0 37 |
| 2 30 | 16 24 | 7 30 | 6 53 | 15 0 | 3 30 | 25 0 | 2 2 | 58 0 | 0 35 |
| 2 35 | 16 4 | 7 35 | 6 49 | 15 10 | 3 28 | 25 10 | 2 1 | 59 0 | 0 34 |
| 2 40 | 15 45 | 7 40 | 6 45 | 15 20 | 3 26 | 25 20 | 2 0 | 60 0 | 0 33 |
| 2 45 | 15 27 | 7 45 | 6 41 | 15 30 | 3 24 | 25 30 | 1 59 | 61 0 | 0 32 |
| 2 50 | 15 9 | 7 50 | 6 37 | 15 40 | 3 21 | 25 40 | 1 58 | 62 0 | 0 30 |
| 2 55 | 14 52 | 7 55 | 6 33 | 15 50 | 3 19 | 25 50 | 1 57 | 63 0 | 0 29 |
| 3 0 | 14 36 | 8 0 | 6 29 | 16 0 | 3 17 | 26 0 | 1 56 | 64 0 | 0 28 |
| 3 5 | 14 20 | 8 5 | 6 25 | 16 10 | 3 15 | 26 10 | 1 55 | 65 0 | 0 26 |
| 3 10 | 14 4 | 8 10 | 6 22 | 16 20 | 3 12 | 26 20 | 1 55 | 66 0 | 0 25 |
| 3 15 | 13 49 | 8 15 | 6 18 | 16 30 | 3 10 | 26 30 | 1 54 | 67 0 | 0 24 |
| 3 20 | 13 34 | 8 20 | 6 15 | 16 40 | 3 8 | 26 40 | 1 53 | 68 0 | 0 23 |
| 3 25 | 13 20 | 8 25 | 6 11 | 16 50 | 3 6 | 26 50 | 1 52 | 69 0 | 0 22 |
| 3 30 | 13 6 | 8 30 | 6 8 | 17 0 | 3 4 | 27 0 | 1 51 | 70 0 | 0 21 |
| 3 35 | 12 53 | 8 35 | 6 5 | 17 10 | 3 3 | 27 15 | 1 50 | 71 0 | 0 19 |
| 3 40 | 12 40 | 8 40 | 6 1 | 17 20 | 3 1 | 27 30 | 1 49 | 72 0 | 0 18 |
| 3 45 | 12 27 | 8 45 | 5 58 | 17 30 | 2 59 | 27 45 | 1 48 | 73 0 | 0 17 |
| 3 50 | 12 15 | 8 50 | 5 55 | 17 40 | 2 57 | 28 0 | 1 47 | 74 0 | 0 16 |
| 3 55 | 12 3 | 8 55 | 5 52 | 17 50 | 2 55 | 28 15 | 1 46 | 75 0 | 0 15 |
| 4 0 | 11 51 | 9 0 | 5 48 | 18 0 | 2 54 | 28 30 | 1 45 | 76 0 | 0 14 |
| 4 5 | 11 40 | 9 5 | 5 45 | 18 10 | 2 52 | 28 45 | 1 44 | 77 0 | 0 13 |
| 4 10 | 11 29 | 9 10 | 5 42 | 18 20 | 2 51 | 29 0 | 1 42 | 78 0 | 0 12 |
| 4 15 | 11 18 | 9 15 | 5 39 | 18 30 | 2 49 | 29 30 | 1 40 | 79 0 | 0 11 |
| 4 20 | 11 8 | 9 20 | 5 36 | 18 40 | 2 47 | 30 0 | 1 38 | 80 0 | 0 10 |
| 4 25 | 10 58 | 9 25 | 5 34 | 18 50 | 2 46 | 30 30 | 1 37 | 81 0 | 0 9 |
| 4 30 | 10 48 | 9 30 | 5 31 | 19 0 | 2 44 | 31 0 | 1 35 | 82 0 | 0 8 |
| 4 35 | 10 39 | 9 35 | 5 28 | 19 10 | 2 43 | 31 30 | 1 33 | 83 0 | 0 7 |
| 4 40 | 10 29 | 9 40 | 5 25 | 19 20 | 2 41 | 32 0 | 1 31 | 84 0 | 0 6 |
| 4 45 | 10 20 | 9 45 | 5 23 | 19 30 | 2 40 | 32 30 | 1 30 | 86 0 | 0 4 |
| 4 50 | 10 11 | 9 50 | 5 20 | 19 40 | 2 38 | 33 0 | 1 28 | 88 0 | 0 2 |
| 4 55 | 10 2 | 9 55 | 5 18 | 19 50 | 2 37 | 33 30 | 1 26 | 90 0 | 0 0 |

# TABLE V.

## Dip of the Horizon.

| Height. | Dip. |
|---|---|
| Feet | ′ ″ |
| 1 | 0 58 |
| 2 | 1 21 |
| 3 | 1 40 |
| 4 | 1 56 |
| 5 | 2 9 |
| 6 | 2 21 |
| 7 | 2 33 |
| 8 | 2 44 |
| 9 | 2 53 |
| 10 | 3 2 |
| 11 | 3 10 |
| 12 | 3 19 |
| 13 | 3 27 |
| 14 | 3 36 |
| 15 | 3 42 |
| 16 | 3 50 |
| 17 | 3 57 |
| 18 | 4 4 |
| 19 | 4 11 |
| 20 | 4 17 |
| 21 | 4 23 |
| 22 | 4 30 |
| 23 | 4 36 |
| 24 | 4 42 |
| 26 | 4 52 |
| 28 | 5 5 |
| 30 | 5 15 |
| 35 | 5 39 |
| 40 | 6 4 |
| 45 | 6 27 |
| 50 | 6 46 |
| 60 | 7 25 |
| 70 | 8 1 |
| 80 | 8 34 |
| 90 | 9 6 |
| 100 | 9 35 |

# TABLE VI.

## Sun's Parallax in Alt.

| Altit. | Parall. |
|---|---|
| ° | ′ |
| 0 | 9 |
| 10 | 9 |
| 20 | 8 |
| 30 | 8 |
| 40 | 7 |
| 50 | 6 |
| 55 | 5 |
| 60 | 4 |
| 65 | 4 |
| 70 | 3 |
| 75 | 2 |
| 80 | 2 |
| 85 | 1 |
| 90 | 0 |

# TAB. VII.

## Moon's Augmentat.

| Alt. | Augm. |
|---|---|
| ° | ′ |
| 0 | 0 |
| 5 | 1 |
| 10 | 3 |
| 15 | 4 |
| 20 | 6 |
| 25 | 7 |
| 30 | 8 |
| 35 | 9 |
| 40 | 10 |
| 45 | 11 |
| 50 | 12 |
| 55 | 13 |
| 60 | 14 |
| 70 | 15 |
| 80 | 15 |
| 90 | 16 |

# TABLE VIII.

## Dip at differ. Distances from the Observer.

| Miles. | Height of the Eye in Feet. | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 10 | 15 | 20 | 25 | 30 |
| ¼ | 11′ | 23′ | 34′ | 45′ | 57′ | 68′ |
| ½ | 6 | 12 | 17 | 23 | 28 | 34 |
| ¾ | 4 | 8 | 12 | 15 | 19 | 23 |
| 1 | 3 | 6 | 9 | 12 | 15 | 17 |
| 1¼ | 3 | 5 | 7 | 10 | 12 | 14 |
| 1½ | 3 | 4 | 6 | 8 | 10 | 12 |
| 2 | 2 | 4 | 5 | 7 | 8 | 9 |
| 2½ | 2 | 3 | 4 | 6 | 7 | 8 |
| 3 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3½ | 2 | 3 | 4 | 5 | 6 | 6 |
| 4 | 2 | 3 | 4 | 5 | 5 | 6 |
| 5 | 2 | 3 | 4 | 4 | 5 | 6 |
| 6 | 2 | 3 | 4 | 4 | 5 | 5 |

For correcting the OBSERVED ALTITUDE of the SUN'S LOWER LIMB, when taken by a Fore Observation.

| Obs. Alt. | Height of the Eye above the Sea in feet. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 |
| 5° 0′ | 3′.8 | 3′.5 | 3′.1 | 2′.8 | 2′.5 | 2′.3 | 2′.1 | 1′.8 | 1′.6 | 1′.4 | 1′.2 | 1′.0 | 0′.8 | 0′.6 | 0′.5 | 0′.3 |
| 5 20 | 4.3 | 4.0 | 3.6 | 3.3 | 3.1 | 2.8 | 2.6 | 2.3 | 2.1 | 1.9 | 1.7 | 1.5 | 1.3 | 1.1 | 1.0 | 0.8 |
| 5 40 | 4.8 | 4.5 | 4.1 | 3.8 | 3.5 | 3.3 | 3.1 | 2.8 | 2.6 | 2.4 | 2.2 | 2.0 | 1.8 | 1.6 | 1.5 | 1.3 |
| 6 0 | 5.3 | 4.9 | 4.6 | 4.3 | 4.0 | 3.7 | 3.5 | 3.3 | 3.0 | 2.8 | 2.6 | 2.4 | 2.2 | 2.1 | 1.9 | 1.7 |
| 6 20 | 5.7 | 5.4 | 5.0 | 4.7 | 4.4 | 4.1 | 3.9 | 3.7 | 3.3 | 3.2 | 3.0 | 2.8 | 2.6 | 2.5 | 2.3 | 2.0 |
| 6 40 | 6.0 | 5.7 | 5.3 | 5.0 | 4.7 | 4.5 | 4.3 | 4.0 | 3.8 | 3.6 | 3.4 | 3.2 | 3.0 | 2.8 | 2.7 | 2.3 |
| 7 0 | 6.4 | 6.0 | 5.7 | 5.4 | 5.1 | 4.8 | 4.6 | 4.4 | 4.1 | 3.9 | 3.7 | 3.5 | 3.3 | 3.2 | 3.0 | 2.7 |
| 7 20 | 6.7 | 6.3 | 6.0 | 5.7 | 5.4 | 5.1 | 4.9 | 4.7 | 4.4 | 4.2 | 4.0 | 3.8 | 3.6 | 3.5 | 3.3 | 3.1 |
| 7 40 | 6.9 | 6.6 | 6.2 | 5.9 | 5.7 | 5.4 | 5.2 | 4.9 | 4.7 | 4.5 | 4.3 | 4.1 | 3.9 | 3.8 | 3.6 | 3.4 |
| 8 0 | 7.2 | 6.8 | 6.5 | 6.2 | 5.9 | 5.7 | 5.4 | 5.3 | 5.0 | 4.8 | 4.6 | 4.4 | 4.2 | 4.0 | 3.9 | 3.7 |
| 8 20 | 7.5 | 7.1 | 6.7 | 6.5 | 6.2 | 5.9 | 5.7 | 5.5 | 5.2 | 5.0 | 4.8 | 4.6 | 4.4 | 4.3 | 4.1 | 3.9 |
| 8 40 | 7.7 | 7.3 | 7.0 | 6.7 | 6.4 | 6.1 | 5.9 | 5.7 | 5.5 | 5.2 | 5.0 | 4.8 | 4.7 | 4.5 | 4.3 | 4.1 |
| 9 0 | 7.9 | 7.5 | 7.2 | 6.9 | 6.6 | 6.4 | 6.1 | 5.9 | 5.7 | 5.5 | 5.3 | 5.1 | 4.9 | 4.7 | 4.5 | 4.4 |
| 9 20 | 8.1 | 7.7 | 7.4 | 7.1 | 6.8 | 6.6 | 6.3 | 6.1 | 5.9 | 5.7 | 5.5 | 5.3 | 5.1 | 4.9 | 4.7 | 4.6 |
| 9 40 | 8.3 | 7.9 | 7.6 | 7.3 | 7.0 | 6.7 | 6.5 | 6.3 | 6.1 | 5.8 | 5.6 | 5.4 | 5.3 | 5.1 | 4.9 | 4.7 |
| 10 0 | 8.5 | 8.1 | 7.8 | 7.5 | 7.2 | 6.9 | 6.7 | 6.5 | 6.2 | 6.0 | 5.8 | 5.6 | 5.4 | 5.3 | 5.1 | 4.9 |
| 10 30 | 8.7 | 8.3 | 8.0 | 7.7 | 7.4 | 7.2 | 6.9 | 6.7 | 6 5 | 6.3 | 6.1 | 5.9 | 5.7 | 5.5 | 5.4 | 5.2 |
| 11 0 | 8.9 | 8.6 | 8.2 | 7.9 | 7.6 | 7.4 | 7.2 | 6.9 | 6.7 | 6.5 | 6.3 | 6.1 | 5.9 | 5.7 | 5.6 | 5.4 |
| 11 30 | 9.1 | 8.8 | 8.4 | 8.1 | 7.8 | 7.6 | 7.4 | 7.1 | 6.9 | 6.7 | 6.5 | 6.3 | 6.1 | 5.9 | 5.8 | 5.6 |
| 12 0 | 9.3 | 9.0 | 8.7 | 8.3 | 8.0 | 7.8 | 7.6 | 7.3 | 7.1 | 6.9 | 6.7 | 6.5 | 6.3 | 6.2 | 6.0 | 5.8 |
| 13 0 | 9.6 | 9.3 | 9.0 | 8.7 | 8.4 | 8.1 | 7.9 | 7.7 | 7.4 | 7.2 | 7.0 | 6.8 | 6.6 | 6.5 | 6.3 | 6.1 |
| 14 0 | 9.9 | 9.6 | 9.2 | 8.9 | 8.7 | 8.4 | 8.2 | 7.9 | 7.7 | 7.5 | 7.3 | 7.1 | 6.9 | 6.8 | 6.6 | 6.4 |
| 15 0 | 10.2 | 9.8 | 9.5 | 9.2 | 8.9 | 8.7 | 8.4 | 8.2 | 8.0 | 7.8 | 7.6 | 7.4 | 7.2 | 7.0 | 6.9 | 6.7 |
| 16 0 | 10.4 | 10.1 | 9.7 | 9.4 | 9.1 | 8.9 | 8.7 | 8.4 | 8.2 | 8.0 | 7.8 | 7.6 | 7.4 | 7.2 | 7.1 | 6.9 |
| 17 0 | 10.6 | 10.3 | 9.9 | 9.6 | 9.3 | 9.1 | 8.9 | 8.6 | 8.3 | 8.2 | 8.0 | 7.8 | 7.6 | 7.4 | 7.3 | 7.1 |
| 18 0 | 10.8 | 10.4 | 10.1 | 9.8 | 9.5 | 9.3 | 9.0 | 8.8 | 8.6 | 8.4 | 8.2 | 8.0 | 7.8 | 7.6 | 7.5 | 7.3 |
| 19 0 | 11.0 | 10.6 | 10.3 | 10.0 | 9.7 | 9.4 | 9.2 | 9.0 | 8.8 | 8.5 | 8.3 | 8.1 | 8.0 | 7.8 | 7.6 | 7.4 |
| 20 0 | 11.1 | 10.7 | 10.4 | 10.1 | 9.8 | 9.6 | 9.3 | 9.1 | 8.9 | 8.7 | 8.5 | 8.2 | 8.1 | 7.9 | 7.7 | 7.6 |
| 21 0 | 11.2 | 10.9 | 10.5 | 10.2 | 10.0 | 9.7 | 9.5 | 9.2 | 9.0 | 8.8 | 8.6 | 8.4 | 8.2 | 8.1 | 7.9 | 7.7 |
| 22 0 | 11.4 | 11.0 | 10.7 | 10.4 | 10.1 | 9.8 | 9.6 | 9.4 | 9.1 | 8.9 | 8.7 | 8.5 | 8.3 | 8.2 | 8.0 | 7.8 |
| 23 0 | 11.5 | 11.1 | 10.8 | 10.5 | 10.2 | 9.9 | 9.7 | 9.5 | 9.2 | 9.0 | 8.8 | 8 6 | 8.4 | 8.3 | 8.1 | 7.9 |
| 24 0 | 11.6 | 11.2 | 10.9 | 10.6 | 10.3 | 10.0 | 9.8 | 9.6 | 9.3 | 9.1 | 8.9 | 8.7 | 8.5 | 8.4 | 8.2 | 8.0 |
| 25 0 | 11.7 | 11.3 | 11.0 | 10.7 | 10.4 | 10.1 | 9.9 | 9.7 | 9.4 | 9.2 | 9.0 | 8.8 | 8.6 | 8.5 | 8.3 | 8.1 |
| 26 0 | 11.7 | 11.4 | 11.0 | 10.7 | 10.5 | 10.2 | 10.0 | 9.7 | 9.5 | 9.3 | 9.1 | 8.9 | 8.7 | 8.6 | 8.4 | 8.2 |
| 27 0 | 11.8 | 11.5 | 11.1 | 10.8 | 10.5 | 10.3 | 10.1 | 9.8 | 9.6 | 9.4 | 9.2 | 9.0 | 8.8 | 8.6 | 8.5 | 8.3 |
| 28 0 | 11.9 | 11.6 | 11.2 | 10.9 | 10.6 | 10.4 | 10.2 | 9.9 | 9.7 | 9.5 | 9.3 | 9.1 | 8.9 | 8.7 | 8.5 | 8.4 |
| 30 0 | 12.0 | 11.7 | 11.3 | 11.0 | 10.8 | 10.5 | 10.3 | 10.0 | 9.8 | 9.6 | 9.4 | 9.2 | 9.0 | 8.9 | 8.7 | 8.5 |
| 32 0 | 12.2 | 11.8 | 11.5 | 11.2 | 10.9 | 10.6 | 10.4 | 10.2 | 9.9 | 9.7 | 9.5 | 9.3 | 9.1 | 9.0 | 8.8 | 8.6 |
| 34 0 | 12.3 | 11.9 | 11.6 | 11.3 | 11.0 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.6 | 9.4 | 9.2 | 9.1 | 8.9 | 8.7 |
| 36 0 | 12.4 | 12.0 | 11.7 | 11.4 | 11.1 | 10.8 | 10.6 | 10.4 | 10.2 | 9.9 | 9.7 | 9.5 | 9.3 | 9.2 | 9.0 | 8.8 |
| 38 0 | 12.5 | 12.1 | 11.8 | 11.5 | 11.2 | 10.9 | 10.7 | 10.5 | 10.2 | 10.0 | 9.8 | 9.6 | 9.4 | 9.3 | 9.1 | 8.9 |
| 40 0 | 12.5 | 12.2 | 11.8 | 11.5 | 11.3 | 11.0 | 10.8 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 | 9.5 | 9.4 | 9.2 | 9.0 |
| 42 0 | 12.6 | 12.2 | 11.9 | 11.6 | 11.3 | 11.1 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.6 | 9.4 | 9.3 | 9.1 |
| 44 0 | 12.7 | 12.3 | 12.0 | 11.7 | 11.4 | 11.1 | 10.9 | 10.7 | 10.5 | 10.2 | 10.1 | 9.8 | 9.7 | 9.5 | 9.3 | 9.1 |
| 46 0 | 12.7 | 12.4 | 12.0 | 11.7 | 11.5 | 11.2 | 11.0 | 10.7 | 10.5 | 10.3 | 10.2 | 9.9 | 9.7 | 9.6 | 9.4 | 9.2 |
| 48 0 | 12.8 | 12.4 | 12.1 | 11.8 | 11.5 | 11.3 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.6 | 9.5 | 9.3 |
| 50 0 | 12.8 | 12.5 | 12.2 | 11.9 | 11.6 | 11.3 | 11.1 | 10.9 | 10.6 | 10.4 | 10.3 | 10.0 | 9.8 | 9.7 | 9.5 | 9.3 |
| 52 0 | 12.9 | 12.5 | 12.2 | 11.9 | 11.6 | 11.4 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 | 9.6 | 9.4 |
| 54 0 | 13.0 | 12.6 | 12.3 | 12.0 | 11.7 | 11.4 | 11.2 | 11.0 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.8 | 9.6 | 9.4 |
| 56 0 | 13.0 | 12.6 | 12.3 | 12.0 | 11.7 | 11.5 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.7 | 9.5 |
| 58 0 | 13.0 | 12.7 | 12.3 | 12.0 | 11.7 | 11.5 | 11.3 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.9 | 9.7 | 9.5 |
| 60 0 | 13.1 | 12.7 | 12.4 | 12.1 | 11.8 | 11.6 | 11.3 | 11.1 | 10.9 | 10.6 | 10.4 | 10.2 | 10.1 | 9.9 | 9.7 | 9.5 |
| 62 0 | 13.1 | 12.8 | 12.4 | 12.1 | 11.8 | 11.6 | 11.4 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.8 | 9.6 |
| 64 0 | 13.2 | 12.8 | 12.5 | 12.2 | 11.9 | 11.6 | 11.4 | 11.2 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 10.0 | 9.8 | 9.6 |
| 66 0 | 13.2 | 12.8 | 12.5 | 12.2 | 11.9 | 11.7 | 11.4 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.7 |
| 70 0 | 13.3 | 12.9 | 12.6 | 12.3 | 12.0 | 11.8 | 11.5 | 11.3 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.1 | 9.9 | 9.7 |
| 80 0 | 13.4 | 13.1 | 12.7 | 12.4 | 12.1 | 11.9 | 11.7 | 11.4 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.1 | 9.9 |
| 90 0 | 13.6 | 13.2 | 12.9 | 12.6 | 12.3 | 12.0 | 11.8 | 11.6 | 11.3 | 11.1 | 10.9 | 10.7 | 10.5 | 10.4 | 10.2 | 10.0 |

| Month | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correct. | +0′.3 | +0′.2 | +0′.1 | 0′.0 | −0′.2 | −0′.2 | −0′.3 | −0′.2 | −0′.1 | +0′.1 | +0′.2 | +0′.3 |

# TABLE X.

## Sun's Declination for the Years 1834, 1838, 1842, 1846, &c.

| Days | Jan. | Feb. | March | April | May | June | July | Aug | Sept. | Oct. | Nov. | Dec. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | South. | South. | South. | North. | North. | North. | North. | North. | North. | South. | South. | South. | |
| | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | |
| 1 | 23 2 | 17 9 | 7 39 | 4 28 | 15 1 | 22 2 | 23 9 | 18 6 | 8 23 | 3 6 | 14 23 | 21 48 | 1 |
| 2 | 22 57 | 16 51 | 7 16 | 4 51 | 15 19 | 22 10 | 23 5 | 17 51 | 8 1 | 3 29 | 14 42 | 21 57 | 2 |
| 3 | 22 51 | 16 34 | 6 53 | 5 14 | 15 37 | 22 18 | 23 0 | 17 36 | 7 39 | 3 53 | 15 1 | 22 6 | 3 |
| 4 | 22 45 | 16 16 | 6 30 | 5 37 | 15 54 | 22 25 | 22 55 | 17 20 | 7 17 | 4 16 | 15 20 | 22 14 | 4 |
| 5 | 22 39 | 15 58 | 6 7 | 6 00 | 16 12 | 22 32 | 22 50 | 17 4 | 6 55 | 4 39 | 15 38 | 22 22 | 5 |
| 6 | 22 32 | 15 40 | 5 44 | 6 23 | 16 29 | 22 38 | 22 44 | 16 48 | 6 33 | 5 2 | 15 57 | 22 30 | 6 |
| 7 | 22 24 | 15 21 | 5 20 | 6 45 | 16 45 | 22 45 | 22 38 | 16 31 | 6 10 | 5 25 | 16 14 | 22 37 | 7 |
| 8 | 22 16 | 15 2 | 4 57 | 7 8 | 17 2 | 22 50 | 22 32 | 16 14 | 5 48 | 5 48 | 16 32 | 22 43 | 8 |
| 9 | 22 8 | 14 43 | 4 34 | 7 30 | 17 18 | 22 56 | 22 25 | 15 57 | 5 25 | 6 11 | 16 49 | 22 50 | 9 |
| 10 | 21 59 | 14 24 | 4 10 | 7 52 | 17 34 | 23 1 | 22 18 | 15 40 | 5 2 | 6 34 | 17 7 | 22 55 | 10 |
| 11 | 21 50 | 14 4 | 3 47 | 8 15 | 17 50 | 23 5 | 22 10 | 15 22 | 4 39 | 6 57 | 17 23 | 23 0 | 11 |
| 12 | 21 41 | 13 45 | 3 23 | 8 37 | 18 5 | 23 9 | 22 2 | 15 4 | 4 17 | 7 19 | 17 40 | 23 5 | 12 |
| 13 | 21 31 | 13 24 | 3 0 | 8 58 | 18 20 | 23 13 | 21 53 | 14 46 | 3 54 | 7 42 | 17 56 | 23 10 | 13 |
| 14 | 21 20 | 13 4 | 2 36 | 9 20 | 18 35 | 23 16 | 21 45 | 14 28 | 3 31 | 8 4 | 18 12 | 23 13 | 14 |
| 15 | 21 10 | 12 44 | 2 12 | 9 42 | 18 49 | 23 19 | 21 35 | 14 9 | 3 8 | 8 27 | 18 27 | 23 17 | 15 |
| 16 | 20 58 | 12 23 | 1 49 | 10 3 | 19 3 | 23 21 | 21 26 | 13 50 | 2 44 | 8 49 | 18 43 | 23 20 | 16 |
| 17 | 20 47 | 12 2 | 1 25 | 10 24 | 19 17 | 23 24 | 21 16 | 13 31 | 2 21 | 9 11 | 18 58 | 23 22 | 17 |
| 18 | 20 35 | 11 41 | 1 1 | 10 45 | 19 30 | 23 25 | 21 6 | 13 12 | 1 58 | 9 33 | 19 12 | 23 24 | 18 |
| 19 | 20 22 | 11 20 | 0 37 | 11 6 | 19 44 | 23 26 | 20 55 | 12 53 | 1 35 | 9 55 | 19 26 | 23 26 | 19 |
| 20 | 20 10 | 10 58 | 0 14 S. | 11 27 | 19 56 | 23 27 | 20 44 | 12 33 | 1 11 | 10 17 | 19 40 | 23 27 | 20 |
| 21 | 19 56 | 10 37 | 0 10 N | 11 47 | 20 9 | 23 28 | 20 33 | 12 13 | 0 48 | 10 38 | 19 54 | 23 28 | 21 |
| 22 | 19 43 | 10 15 | 0 34 | 12 8 | 20 21 | 23 28 | 20 21 | 11 53 | 0 25 | 10 59 | 20 7 | 23 28 | 22 |
| 23 | 19 29 | 9 53 | 0 57 | 12 28 | 20 33 | 23 27 | 20 9 | 11 33 | 0 1 N | 11 21 | 20 20 | 23 27 | 23 |
| 24 | 19 15 | 9 31 | 1 21 | 12 48 | 20 44 | 23 26 | 19 57 | 11 12 | 0 22 S | 11 42 | 20 32 | 23 26 | 24 |
| 25 | 19 0 | 9 9 | 1 44 | 13 7 | 20 55 | 23 25 | 19 44 | 10 52 | 0 46 | 12 2 | 20 44 | 23 25 | 25 |
| 26 | 18 45 | 8 47 | 2 8 | 13 27 | 21 6 | 23 23 | 19 31 | 10 31 | 1 9 | 12 23 | 20 56 | 23 23 | 26 |
| 27 | 18 30 | 8 24 | 2 31 | 13 46 | 21 16 | 23 21 | 19 18 | 10 10 | 1 32 | 12 44 | 21 7 | 23 21 | 27 |
| 28 | 18 14 | 8 2 | 2 55 | 14 5 | 21 26 | 23 19 | 19 4 | 9 49 | 1 56 | 13 4 | 21 18 | 23 19 | 28 |
| 29 | 17 58 | | 3 18 | 14 24 | 21 36 | 23 16 | 18 50 | 9 28 | 2 19 | 13 24 | 21 28 | 23 15 | 29 |
| 30 | 17 42 | | 3 42 | 14 42 | 21 45 | 23 13 | 18 36 | 9 6 | 2 43 | 13 44 | 21 38 | 23 12 | 30 |
| 31 | 17 26 | | 4 5 | | 21 54 | | 18 21 | 8 45 | | 14 4 | | 23 8 | 31 |

# TABLE XI. To correct the Sun's Declination.

When Declin. { add in W. Long. / sub. in E. Long. } is increasing,

When Declin. { sub. in W. Long. / add in E. Long. } is decreasing,

| Long. | Sun's Declination | | | | | | | | | | | | | | | | | | | | | | | | Long. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° 0 | ° 1 | ° 2 | ° 3 | ° 4 | ° 5 | ° 6 | ° 7 | ° 8 | ° 9 | ° 10 | ° 11 | ° 12 | ° 13 | ° 14 | ° 15 | ° 16 | ° 17 | ° 18 | ° 19 | ° 20 | ° 21 | ° 22 | ° 23 | ° 23½ | |
| ° | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ° |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 20 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 20 |
| 30 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 30 |
| 40 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 40 |
| 50 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 50 |
| 60 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 60 |
| 70 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 70 |
| 80 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 1 | 0 | 80 |
| 90 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 3 | 2 | 1 | 0 | 90 |
| 100 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | 2 | 1 | 0 | 100 |
| 110 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 1 | 0 | 110 |
| 120 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 4 | 4 | 3 | 2 | 0 | 120 |
| 130 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 4 | 3 | 2 | 0 | 130 |
| 140 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 4 | 3 | 2 | 0 | 140 |
| 150 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 4 | 2 | 0 | 150 |
| 160 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 2 | 0 | 160 |
| 170 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 5 | 4 | 2 | 0 | 170 |
| 180 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 5 | 4 | 2 | 0 | 180 |

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## TABLE X.

### Sun's Declination for the Years 1835, 1839, 1843, 1847, &c.

| Days | Jan. South. | Feb. South. | March South. | April North. | May North. | June North. | July North. | Aug North. | Sept. North. | Oct. South. | Nov. South. | Dec. South. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | |
| 1 | 23 3 | 17 13 | 7 44 | 4 23 | 14 57 | 22 0 | 23 10 | 18 10 | 8 28 | 3 0 | 14 18 | 21 46 | 1 |
| 2 | 22 58 | 16 56 | 7 21 | 4 46 | 15 15 | 22 8 | 23 6 | 17 55 | 8 6 | 3 24 | 14 38 | 21 55 | 2 |
| 3 | 22 53 | 16 38 | 6 59 | 5 9 | 15 33 | 22 16 | 23 1 | 17 39 | 7 44 | 3 47 | 14 57 | 22 4 | 3 |
| 4 | 22 47 | 16 21 | 6 36 | 5 32 | 15 50 | 22 23 | 22 57 | 17 24 | 7 22 | 4 10 | 15 15 | 22 12 | 4 |
| 5 | 22 40 | 16 3 | 6 12 | 5 55 | 16 8 | 22 30 | 22 51 | 17 8 | 7 0 | 4 34 | 15 34 | 22 20 | 5 |
| 6 | 22 33 | 15 44 | 5 49 | 6 17 | 16 25 | 22 37 | 22 46 | 16 51 | 6 38 | 4 57 | 15 52 | 22 28 | 6 |
| 7 | 22 26 | 15 26 | 5 26 | 6 40 | 16 42 | 22 43 | 22 40 | 16 35 | 6 16 | 5 20 | 16 10 | 22 35 | 7 |
| 8 | 22 18 | 15 7 | 5 3 | 7 2 | 16 58 | 22 49 | 22 33 | 16 18 | 5 53 | 5 43 | 16 28 | 22 42 | 8 |
| 9 | 22 10 | 14 48 | 4 39 | 7 25 | 17 14 | 22 54 | 22 27 | 16 1 | 5 30 | 6 6 | 16 45 | 22 48 | 9 |
| 10 | 22 2 | 14 29 | 4 16 | 7 47 | 17 30 | 22 59 | 22 19 | 15 44 | 5 8 | 6 28 | 17 2 | 22 54 | 10 |
| 11 | 21 53 | 14 9 | 3 52 | 8 9 | 17 46 | 23 4 | 22 12 | 15 26 | 4 45 | 6 51 | 17 19 | 22 59 | 11 |
| 12 | 21 43 | 13 49 | 3 29 | 8 31 | 18 1 | 23 8 | 22 4 | 15 8 | 4 22 | 7 14 | 17 36 | 23 4 | 12 |
| 13 | 21 33 | 13 29 | 3 5 | 8 53 | 18 16 | 23 12 | 21 55 | 14 50 | 3 59 | 7 37 | 17 52 | 23 9 | 13 |
| 14 | 21 23 | 13 9 | 2 42 | 9 15 | 18 31 | 23 15 | 21 47 | 14 32 | 3 36 | 7 59 | 18 8 | 23 13 | 14 |
| 15 | 21 12 | 12 49 | 2 18 | 9 37 | 18 46 | 23 18 | 21 38 | 14 14 | 3 13 | 8 21 | 18 24 | 23 16 | 15 |
| 16 | 21 1 | 12 28 | 1 54 | 9 58 | 19 0 | 23 21 | 21 28 | 13 55 | 2 50 | 8 44 | 18 39 | 23 19 | 16 |
| 17 | 20 50 | 12 7 | 1 31 | 10 19 | 19 14 | 23 23 | 21 18 | 13 36 | 2 27 | 9 6 | 18 54 | 23 22 | 17 |
| 18 | 20 38 | 11 46 | 1 7 | 10 40 | 19 27 | 23 25 | 21 8 | 13 17 | 2 4 | 9 28 | 19 9 | 23 24 | 18 |
| 19 | 20 25 | 11 25 | 0 43 | 11 1 | 19 40 | 23 26 | 20 58 | 12 57 | 1 40 | 9 50 | 19 23 | 23 26 | 19 |
| 20 | 20 13 | 11 4 | 0 20 S. | 11 22 | 19 53 | 23 27 | 20 47 | 12 38 | 1 17 | 10 11 | 19 37 | 23 27 | 20 |
| 21 | 20 0 | 10 42 | 0 4 N | 11 42 | 20 6 | 23 28 | 20 36 | 12 18 | 0 54 | 10 33 | 19 51 | 23 27 | 21 |
| 22 | 19 46 | 10 20 | 0 28 | 12 3 | 20 18 | 23 28 | 20 24 | 11 58 | 0 30 | 10 54 | 20 4 | 23 28 | 22 |
| 23 | 19 33 | 9 59 | 0 51 | 12 23 | 20 30 | 23 27 | 20 12 | 11 38 | 0 7 N | 11 16 | 20 17 | 23 27 | 23 |
| 24 | 19 18 | 9 37 | 1 15 | 12 43 | 20 41 | 23 27 | 20 0 | 11 17 | 0 17 S | 11 37 | 20 29 | 23 27 | 24 |
| 25 | 19 4 | 9 14 | 1 39 | 13 3 | 20 52 | 23 25 | 19 47 | 10 57 | 0 40 | 11 58 | 20 41 | 23 26 | 25 |
| 26 | 18 49 | 8 52 | 2 2 | 13 22 | 21 3 | 23 24 | 19 34 | 10 36 | 1 4 | 12 18 | 20 53 | 23 24 | 26 |
| 27 | 18 34 | 8 30 | 2 26 | 13 42 | 21 14 | 23 22 | 19 21 | 10 15 | 1 27 | 12 39 | 21 4 | 23 22 | 27 |
| 28 | 18 18 | 8 7 | 2 49 | 14 1 | 21 24 | 23 20 | 19 7 | 9 54 | 1 50 | 12 59 | 21 15 | 23 19 | 28 |
| 29 | 18 2 | | 3 13 | 14 20 | 21 33 | 23 17 | 18 53 | 9 33 | 2 14 | 13 19 | 21 26 | 23 16 | 29 |
| 30 | 17 46 | | 3 36 | 14 38 | 21 43 | 23 14 | 18 39 | 9 11 | 2 37 | 13 39 | 21 36 | 23 13 | 30 |
| 31 | 17 30 | | 3 59 | | 21 52 | | 18 25 | 8 50 | | 13 59 | | 23 9 | 31 |

## TABLE XI. To correct the Sun's Declination.

When Declin. is increasing, { add in W. Long. / sub. in E. Long. }

When Declin. is decreasing, { sub. in W. Long. / add in E. Long. }

| Long. | SUN'S DECLINATION. 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 23½ | Long. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ° |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 20 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 20 |
| 30 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 30 |
| 40 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 40 |
| 50 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 50 |
| 60 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 60 |
| 70 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 70 |
| 80 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 1 | 0 | 80 |
| 90 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 3 | 2 | 1 | 0 | 90 |
| 100 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | 2 | 1 | 0 | 100 |
| 110 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 1 | 0 | 110 |
| 120 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 4 | 4 | 3 | 2 | 0 | 120 |
| 130 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 4 | 3 | 2 | 0 | 130 |
| 140 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 4 | 3 | 2 | 0 | 140 |
| 150 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 4 | 2 | 0 | 150 |
| 160 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 2 | 0 | 160 |
| 170 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 5 | 4 | 2 | 0 | 170 |
| 180 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 5 | 4 | 2 | 0 | 180 |

## Sun's Declination for the Years 1836, 1840, 1844, 1848, &c.

| Days | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | South. | South. | South. | North. | North. | North. | North. | North. | North. | South. | South. | South. | |
| | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | |
| 1 | 23 4 | 17 17 | 7 27 | 4 40 | 15 10 | 22 6 | 23 7 | 17 58 | 8 12 | 3 18 | 14 33 | 21 53 | 1 |
| 2 | 22 59 | 17 0 | 7 4 | 5 3 | 15 28 | 22 14 | 23 2 | 17 43 | 7 50 | 3 41 | 14 52 | 22 2 | 2 |
| 3 | 22 54 | 16 42 | 6 41 | 5 26 | 15 46 | 22 22 | 22 58 | 17 28 | 7 28 | 4 5 | 15 11 | 22 10 | 3 |
| 4 | 22 48 | 16 25 | 6 18 | 5 49 | 16 3 | 22 29 | 22 53 | 17 12 | 7 6 | 4 28 | 15 29 | 22 18 | 4 |
| 5 | 22 42 | 16 7 | 5 55 | 6 12 | 16 21 | 22 35 | 22 47 | 16 55 | 6 43 | 4 51 | 15 48 | 22 26 | 5 |
| 6 | 22 35 | 15 49 | 5 32 | 6 35 | 16 38 | 22 42 | 22 41 | 16 39 | 6 21 | 5 14 | 16 6 | 22 33 | 6 |
| 7 | 22 28 | 15 30 | 5 8 | 6 57 | 16 54 | 22 48 | 22 35 | 16 22 | 5 59 | 5 37 | 16 23 | 22 40 | 7 |
| 8 | 22 20 | 15 12 | 4 45 | 7 20 | 17 10 | 22 53 | 22 28 | 16 5 | 5 36 | 6 0 | 16 41 | 22 46 | 8 |
| 9 | 22 12 | 14 53 | 4 21 | 7 42 | 17 27 | 22 58 | 22 21 | 15 48 | 5 13 | 6 23 | 16 58 | 22 52 | 9 |
| 10 | 22 4 | 14 33 | 3 58 | 8 4 | 17 42 | 23 3 | 22 14 | 15 31 | 4 51 | 6 46 | 17 15 | 22 58 | 10 |
| 11 | 21 55 | 14 14 | 3 34 | 8 26 | 17 58 | 23 7 | 22 6 | 15 13 | 4 28 | 7 8 | 17 32 | 23 3 | 11 |
| 12 | 21 45 | 13 54 | 3 11 | 8 48 | 18 13 | 23 11 | 21 57 | 14 55 | 4 5 | 7 31 | 17 48 | 23 8 | 12 |
| 13 | 21 36 | 13 34 | 2 47 | 9 10 | 18 28 | 23 15 | 21 49 | 14 37 | 3 42 | 7 53 | 18 4 | 23 12 | 13 |
| 14 | 21 25 | 13 14 | 2 24 | 9 31 | 18 42 | 23 18 | 21 40 | 14 18 | 3 19 | 8 16 | 18 20 | 23 15 | 14 |
| 15 | 21 15 | 12 54 | 2 0 | 9 53 | 18 57 | 23 20 | 21 30 | 13 59 | 2 56 | 8 38 | 18 35 | 23 18 | 15 |
| 16 | 21 4 | 12 33 | 1 36 | 10 14 | 19 11 | 23 23 | 21 21 | 13 40 | 2 33 | 9 0 | 18 50 | 23 21 | 16 |
| 17 | 20 52 | 12 12 | 1 13 | 10 35 | 19 24 | 23 24 | 21 11 | 13 21 | 2 9 | 9 22 | 19 5 | 23 23 | 17 |
| 18 | 20 41 | 11 51 | 0 49 | 10 56 | 19 37 | 23 26 | 21 0 | 13 2 | 1 46 | 9 44 | 19 19 | 23 25 | 18 |
| 19 | 20 28 | 11 30 | 0 25 | 11 17 | 19 50 | 23 27 | 20 49 | 12 43 | 1 23 | 10 6 | 19 33 | 23 26 | 19 |
| 20 | 20 16 | 11 9 | 0 1 S | 11 38 | 20 3 | 23 27 | 20 38 | 12 23 | 0 59 | 10 27 | 19 47 | 23 27 | 20 |
| 21 | 20 3 | 10 47 | 0 22 N | 11 58 | 20 15 | 23 28 | 20 27 | 12 3 | 0 36 | 10 49 | 20 1 | 23 28 | 21 |
| 22 | 19 50 | 10 26 | 0 46 | 12 18 | 20 27 | 23 27 | 20 15 | 11 43 | 0 13 N | 11 10 | 20 13 | 23 28 | 22 |
| 23 | 19 36 | 10 4 | 1 10 | 12 38 | 20 39 | 23 27 | 20 3 | 11 22 | 0 11 S | 11 31 | 20 26 | 23 27 | 23 |
| 24 | 19 22 | 9 42 | 1 33 | 12 58 | 20 50 | 23 26 | 19 50 | 11 2 | 0 34 | 11 52 | 20 38 | 23 26 | 24 |
| 25 | 19 7 | 9 20 | 1 57 | 13 18 | 21 1 | 23 24 | 19 37 | 10 41 | 0 58 | 12 13 | 20 50 | 23 24 | 25 |
| 26 | 18 53 | 8 57 | 2 20 | 13 37 | 21 11 | 23 22 | 19 24 | 10 20 | 1 21 | 12 34 | 21 2 | 23 22 | 26 |
| 27 | 18 37 | 8 35 | 2 44 | 13 56 | 21 21 | 23 20 | 19 11 | 9 59 | 1 44 | 12 54 | 21 13 | 23 20 | 27 |
| 28 | 18 22 | 8 12 | 3 7 | 14 15 | 21 31 | 23 17 | 18 57 | 9 38 | 2 8 | 13 14 | 21 23 | 23 17 | 28 |
| 29 | 18 6 | 7 50 | 3 30 | 14 34 | 21 41 | 23 14 | 18 43 | 9 17 | 2 31 | 13 34 | 21 33 | 23 14 | 29 |
| 30 | 17 50 | | 3 54 | 14 52 | 21 50 | 23 11 | 18 28 | 8 55 | 2 55 | 13 54 | 21 43 | 23 10 | 30 |
| 31 | 17 34 | | 4 17 | | 21 58 | | 18 14 | 8 33 | | 14 14 | | 23 5 | 31 |

## TABLE XII.

To correct the Sun's Declination for the changes in periods of Four Years.

| Periods of Years. | MONTHS. | | | | | | | | | | | | | | | Periods of Years. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | January. | | | | | February. | | | | | March. | | | | | |
| | Days. | | | | | Days. | | | | | Days. | | | | | |
| | 1 | 7 | 13 | 19 | 25 | 1 | 7 | 13 | 19 | 25 | 1 | 7 | 13 | 19 | 25 | |
| | sub. | sub. | sub. | sub. | sub. | sub. | sub. | sub. | sub. | sub. | sub. | sub. | sub. | sub. | add. | |
| | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 12 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 12 |
| 16 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 16 |
| 20 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 20 |
| | April. | | | | | May. | | | | | June. | | | | | |
| | Days. | | | | | Days. | | | | | Days. | | | | | |
| | 1 | 7 | 13 | 19 | 25 | 1 | 7 | 13 | 19 | 25 | 1 | 7 | 13 | 19 | 25 | |
| | add. | add. | add. | add. | add. | add. | add. | add. | add. | add. | add. | add. | add. | | | |
| | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 8 |
| 12 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 12 |
| 16 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 16 |
| 20 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 20 |

## TABLE X.

### Sun's Declination for the Years 1837, 1841, 1845, 1849, &c.

| Days. | Jan. South. | Feb. South. | March South. | April North. | May North. | June North. | July North. | Aug. North. | Sept. North. | Oct. South. | Nov. South. | Dec. South. | Days. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | |
| 1 | 23 1 | 17 4 | 7 32 | 4 35 | 15 6 | 22 4 | 23 8 | 18 2 | 8 17 | 3 12 | 14 28 | 21 50 | 1 |
| 2 | 22 55 | 16 47 | 7 10 | 4 58 | 15 24 | 22 12 | 23 4 | 17 47 | 7 55 | 3 36 | 14 47 | 21 59 | 2 |
| 3 | 22 50 | 16 29 | 6 47 | 5 21 | 15 42 | 22 20 | 22 59 | 17 31 | 7 33 | 3 59 | 15 6 | 22 8 | 3 |
| 4 | 22 43 | 16 11 | 6 24 | 5 44 | 15 59 | 22 27 | 22 54 | 17 16 | 7 11 | 4 22 | 15 25 | 22 16 | 4 |
| 5 | 22 37 | 15 53 | 6 1 | 6 6 | 16 16 | 22 34 | 22 49 | 16 59 | 6 49 | 4 45 | 15 43 | 22 24 | 5 |
| 6 | 22 30 | 15 35 | 5 37 | 6 29 | 16 33 | 22 40 | 22 43 | 16 43 | 6 27 | 5 8 | 16 1 | 22 32 | 6 |
| 7 | 22 22 | 15 16 | 5 14 | 6 52 | 16 50 | 22 46 | 22 36 | 16 26 | 6 4 | 5 32 | 16 19 | 22 39 | 7 |
| 8 | 22 14 | 14 57 | 4 51 | 7 14 | 17 6 | 22 52 | 22 30 | 16 10 | 5 42 | 5 54 | 16 37 | 22 45 | 8 |
| 9 | 22 6 | 14 38 | 4 27 | 7 36 | 17 23 | 22 57 | 22 23 | 15 52 | 5 19 | 6 17 | 16 54 | 22 51 | 9 |
| 10 | 21 57 | 14 19 | 4 4 | 7 59 | 17 38 | 23 2 | 22 16 | 15 35 | 4 56 | 6 40 | 17 11 | 22 57 | 10 |
| 11 | 21 48 | 13 59 | 3 40 | 8 21 | 17 54 | 23 6 | 22 8 | 15 17 | 4 33 | 7 3 | 17 28 | 23 2 | 11 |
| 12 | 21 38 | 13 39 | 3 17 | 8 43 | 18 9 | 23 10 | 22 0 | 14 59 | 4 10 | 7 26 | 17 44 | 23 7 | 12 |
| 13 | 21 28 | 13 19 | 2 53 | 9 4 | 18 24 | 23 14 | 21 51 | 14 41 | 3 47 | 7 48 | 18 0 | 23 11 | 13 |
| 14 | 21 18 | 12 59 | 2 29 | 9 26 | 18 39 | 23 17 | 21 42 | 14 23 | 3 24 | 8 11 | 18 16 | 23 14 | 14 |
| 15 | 21 7 | 12 38 | 2 6 | 9 48 | 18 53 | 23 20 | 21 33 | 14 4 | 3 1 | 8 33 | 18 32 | 23 18 | 15 |
| 16 | 20 55 | 12 17 | 1 42 | 10 9 | 19 7 | 23 22 | 21 23 | 13 45 | 2 38 | 8 55 | 18 47 | 23 21 | 16 |
| 17 | 20 43 | 11 56 | 1 18 | 10 30 | 19 21 | 23 24 | 21 13 | 13 26 | 2 15 | 9 17 | 19 2 | 23 23 | 17 |
| 18 | 20 31 | 11 35 | 0 55 | 10 51 | 19 34 | 23 26 | 21 3 | 13 7 | 1 52 | 9 39 | 19 16 | 23 25 | 18 |
| 19 | 20 19 | 11 14 | 0 31 | 11 12 | 19 47 | 23 27 | 20 52 | 12 47 | 1 28 | 10 1 | 19 30 | 23 26 | 19 |
| 20 | 20 6 | 10 53 | 0 7 S | 11 33 | 20 0 | 23 27 | 20 41 | 12 27 | 1 5 | 10 22 | 19 44 | 23 27 | 20 |
| 21 | 19 53 | 10 31 | 0 16 N | 11 53 | 20 12 | 23 28 | 20 30 | 12 7 | 0 42 | 10 44 | 19 57 | 23 28 | 21 |
| 22 | 19 39 | 10 9 | 0 40 | 12 13 | 20 24 | 23 28 | 20 18 | 11 47 | 0 18 N | 11 5 | 20 10 | 23 28 | 22 |
| 23 | 19 25 | 9 47 | 1 4 | 12 33 | 20 36 | 23 27 | 20 6 | 11 27 | 0 5 S | 11 26 | 20 23 | 23 27 | 23 |
| 24 | 19 11 | 9 25 | 1 27 | 12 53 | 20 47 | 23 26 | 19 53 | 11 7 | 0 29 | 11 47 | 20 35 | 23 26 | 24 |
| 25 | 18 56 | 9 3 | 1 51 | 13 13 | 20 58 | 23 25 | 19 40 | 10 46 | 0 52 | 12 8 | 20 47 | 23 25 | 25 |
| 26 | 18 41 | 8 40 | 2 14 | 13 32 | 21 9 | 23 23 | 19 27 | 10 25 | 1 16 | 12 29 | 20 59 | 23 23 | 26 |
| 27 | 18 26 | 8 18 | 2 38 | 13 51 | 21 19 | 23 21 | 19 14 | 10 4 | 1 39 | 12 49 | 21 10 | 23 21 | 27 |
| 28 | 18 10 | 7 55 | 3 1 | 14 10 | 21 29 | 23 18 | 19 0 | 9 43 | 2 2 | 13 9 | 21 21 | 23 18 | 28 |
| 29 | 17 54 | | 3 25 | 14 29 | 21 38 | 23 15 | 18 46 | 9 22 | 2 26 | 13 29 | 21 31 | 23 14 | 29 |
| 30 | 17 38 | | 3 48 | 14 48 | 21 47 | 23 12 | 18 32 | 9 0 | 2 49 | 13 49 | 21 41 | 23 11 | 30 |
| 31 | 17 21 | | 4 11 | | 21 56 | | 18 17 | 8 39 | | 14 9 | | 23 7 | 31 |

## TABLE XII.

### To correct the Sun's Declination for the changes in periods of Four Years.

| Periods of Years. | MONTHS. July. Days. 1 | 7 | 13 | 19 | 25 | August. Days. 1 | 7 | 13 | 19 | 25 | September. Days. 1 | 7 | 13 | 19 | 25 | Periods of Years. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | sub. ′ | add. ′ | |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 12 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 12 |
| 16 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 16 |
| 20 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 20 |

| Periods of Years. | October. Days. 1 | 7 | 13 | 19 | 25 | November. Days. 1 | 7 | 13 | 19 | 25 | December. Days. 1 | 7 | 13 | 19 | 25 | Periods of Years. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | add. ′ | ′ | ′ | |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 8 |
| 12 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 12 |
| 16 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 16 |
| 20 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 20 |

# TABLE XIII.

## The RIGHT ASCENSIONS and DECLINATIONS of the PRINCIPAL FIXED STARS, adapted to JANUARY 1834.

| Charac. | Constellations. | Pr. Names. | Magnitudes. | Right Ascension in Time. | Ann. Var. | Declination. | Ann. Var. |
|---|---|---|---|---|---|---|---|
| | | | | h. m. s. | s. | ° ′ ″ | ″ |
| γ | Pegasus | *Algenib* | 2.3 | 0 4 42 | + 3.08 | 14 15 38 N | + 20.05 |
| α | Cassiopeia | *Schedar* | 3 | 0 31 8 | + 3.34 | 55 37 33 N | + 19.87 |
| β | Andromeda | *Mirach* | 2 | 1 0 29 | + 3.30 | 34 44 20 N | + 19.41 |
| α | Ursa Minor | *Pole Star* | 2.3 | 1 0 34 | +15.90 | 88 25 26 N | + 19.36 |
| α | Eridanus | *Achernar* | 1 | 1 31 31 | + 2.24 | 58 4 54 S | − 18.48 |
| α | Aries | ARIETIS | 3 | 1 57 50 | + 3.35 | 22 40 27 N | + 17.46 |
| α | Cetus | *Menkar* | 2.3 | 2 53 37 | + 3.13 | 3 26 3 N | + 14.57 |
| β | Perseus | *Algol* | Var. | 2 57 23 | + 3.85 | 40 18 36 N | + 14.31 |
| α | Perseus | | 2.3 | 3 12 31 | + 4.23 | 49 15 48 N | + 13.39 |
| α | Taurus | ALDEBARAN | 1 | 4 26 24 | + 3.43 | 16 10 9 N | + 7.96 |
| α | Auriga | *Capella* | 1 | 5 4 26 | + 4.41 | 45 49 14 N | + 4.81 |
| β | Orion | *Rigel* | 1 | 5 6 34 | + 2.88 | 8 23 57 S | − 4.63 |
| β | Taurus | | 2 | 5 15 48 | + 3.78 | 28 27 35 N | + 3.84 |
| γ | Orion | *Bellatrix* | 2 | 5 16 14 | + 3.21 | 6 11 35 N | + 3.80 |
| δ | Orion | | 2 | 5 23 32 | + 3.06 | 0 25 42 S | − 3.18 |
| ε | Orion | | 2.3 | 5 27 48 | + 3.04 | 1 18 51 S | − 2.81 |
| α | Columba | | 2 | 5 33 38 | + 2.17 | 34 10 10 S | − 2.30 |
| α | Orion | *Betelgueux* | 1 | 5 46 11 | + 3.24 | 7 22 10 N | − 1.21 |
| α | Argo | *Canopus* | 1 | 6 20 16 | + 1.33 | 52 26 27 S | + 1.77 |
| α | Canis Major | *Sirius* | 1 | 6 37 50 | + 2.65 | 16 29 38 S | + 4.44 |
| α | Gemini | *Castor* | 3 | 7 24 00 | + 3.86 | 32 14 42 N | − 7.19 |
| α | Canis Minor | *Procyon* | 1.2 | 7 30 37 | + 3.14 | 5 38 41 N | − 8.71 |
| β | Gemini | POLLUX | 2 | 7 35 9 | + 3.68 | 28 25 14 N | − 8.09 |
| ξ | Argo Navis | | 2 | 7 57 45 | + 2.11 | 39 32 14 S | + 9.73 |
| γ | Argo Navis | | 2 | 8 4 25 | + 1.85 | 46 51 4 S | + 10.35 |
| δ | Argo Navis | | 2 | 8 40 8 | + 1.66 | 54 6 17 S | + 12.88 |
| β | Argo Navis | | 1 | 9 11 24 | + 0.74 | 69 2 15 S | + 14.84 |
| α | Hydra | *Alphard* | 2 | 9 19 26 | + 2.95 | 7 56 33 S | + 15.33 |
| α | Leo | REGULUS | 1 | 9 59 32 | + 3.22 | 12 46 34 N | − 17.35 |
| β | Ursa Major | | 2 | 10 51 47 | + 3.71 | 57 16 14 N | − 19.10 |
| α | Ursa Major | *Dubhe* | 1.2 | 10 53 25 | + 3.81 | 62 38 45 N | − 19.22 |
| β | Leo | *Deneb* | 2.3 | 11 40 35 | + 3.07 | 15 30 1 N | − 19.98 |
| γ | Ursa Major | | 2 | 11 45 4 | + 3.19 | 54 37 5 N | − 20.01 |
| α | Crux | | 1 | 12 17 26 | + 3.26 | 62 10 44 S | + 20.00 |
| γ | Crux | | 2 | 12 21 59 | + 3.24 | 56 10 41 S | + 19.97 |
| α | Virgo | SPICA | 1 | 13 16 27 | + 3.15 | 10 17 31 S | + 18.95 |
| η | Ursa Major | *Benetnach* | 2.3 | 13 40 59 | + 2.35 | 50 8 40 N | − 18.14 |
| β | Centaur | | 1 | 13 52 11 | + 4.14 | 59 34 6 S | + 17.70 |
| α | Draco | | 2 | 13 59 53 | + 1.61 | 65 10 16 N | − 17.41 |
| α | Bootes | *Arcturus* | 1 | 14 8 6 | + 2.73 | 20 3 2 N | − 18.96 |
| γ | Bootes | *Seginus* | 3 | 14 25 23 | + 2.43 | 39 2 15 N | − 16.20 |
| α | Centaur | | 1 | 14 28 27 | + 4.48 | 60 8 39 S | + 15.99 |
| α | 2 Libra | *Zubenesch* | 3 | 14 41 43 | + 3.31 | 15 20 47 S | + 15.27 |
| β | Libra | *Zubenelg* | 2.3 | 15 8 5 | + 3.22 | 8 45 53 S | + 13.67 |
| α | Corona Borealis | *Alphacca* | 2 | 15 27 40 | + 2.53 | 27 16 42 N | − 12.37 |
| α | Serpens | | 2.3 | 15 36 6 | + 2.94 | 6 57 14 N | − 11.78 |
| α | Scorpio | ANTARES | 1 | 16 19 14 | + 3.66 | 26 3 18 S | + 8.53 |
| α | Hercules | *Ras Algethi* | 3.4 | 17 7 5 | + 2.73 | 14 35 9 N | − 4.59 |
| α | Ophiuchus | *Ras Alhague* | 2 | 17 27 14 | + 2.77 | 12 41 16 N | − 2.86 |
| γ | Draco | *Rastaban* | 2 | 17 52 45 | + 1.39 | 51 30 41 N | − 0.63 |
| α | Lyra | *Vega* | 1 | 18 31 19 | + 2.01 | 38 38 00 N | + 2.73 |
| α | AQUILÆ | ALTAIR | 1.2 | 19 42 41 | + 2.93 | 8 26 8 N | + 8.69 |
| α | Pavo | | 2 | 20 12 28 | + 4.81 | 57 15 27 S | − 10.96 |
| α | Cygnus | *Deneb* | 1 | 20 35 47 | + 2.04 | 44 41 26 N | + 12.61 |
| α | Cepheus | *Alderaimin* | 3 | 21 14 37 | + 1.42 | 61 53 3 N | + 15.06 |
| α | Aquarius | | 3 | 21 57 15 | + 3.08 | 1 7 22 S | − 17.25 |
| α | Grux | | 2 | 21 57 44 | + 3.82 | 47 45 36 S | − 17.27 |
| α | Pisc. Australis | FOMALHAUT | 1 | 22 48 28 | + 3.31 | 30 29 58 S | − 19.09 |
| β | Pegasus | *Scheat* | 2 | 22 55 42 | + 2.87 | 27 11 2 N | + 19.31 |
| α | PEGASUS | MARCAB | 2 | 22 56 30 | + 2.98 | 14 18 51 N | + 19.29 |
| α | Andromeda | *Alpheratz* | 1 | 23 59 49 | + 3.07 | 28 10 27 N | + 20.06 |

# TABLE XIV.

## SUN'S MEAN RIGHT ASCENSION.

| Days. | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Days. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | |
| 1 | 18 46 | 20 58 | 22 48 | 0 42 | 2 33 | 4 35 | 6 40 | 8 45 | 10 41 | 12 29 | 14 25 | 16 29 | 1 |
| 2 | 18 50 | 21 02 | 22 52 | 0 45 | 2 37 | 4 40 | 6 44 | 8 49 | 10 44 | 12 32 | 14 29 | 16 33 | 2 |
| 3 | 18 54 | 21 06 | 22 56 | 0 49 | 2 40 | 4 44 | 6 48 | 8 52 | 10 48 | 12 36 | 14 33 | 16 37 | 3 |
| 4 | 18 59 | 21 10 | 22 59 | 0 53 | 2 44 | 4 48 | 6 52 | 8 56 | 10 52 | 12 40 | 14 37 | 16 42 | 4 |
| 5 | 19 03 | 21 14 | 23 03 | 0 56 | 2 48 | 4 52 | 6 56 | 9 00 | 10 55 | 12 43 | 14 41 | 16 46 | 5 |
| 6 | 19 08 | 21 18 | 23 07 | 1 00 | 2 52 | 4 56 | 7 00 | 9 04 | 10 59 | 12 47 | 14 45 | 16 51 | 6 |
| 7 | 19 12 | 21 22 | 23 10 | 1 04 | 2 56 | 5 00 | 7 04 | 9 08 | 11 02 | 12 51 | 14 49 | 16 55 | 7 |
| 8 | 19 16 | 21 26 | 23 14 | 1 07 | 3 00 | 5 04 | 7 09 | 9 12 | 11 06 | 12 54 | 14 53 | 16 59 | 8 |
| 9 | 19 21 | 21 30 | 23 18 | 1 11 | 3 04 | 5 08 | 7 13 | 9 15 | 11 10 | 12 58 | 14 57 | 17 04 | 9 |
| 10 | 19 25 | 21 34 | 23 21 | 1 15 | 3 08 | 5 13 | 7 17 | 9 19 | 11 13 | 13 02 | 15 01 | 17 08 | 10 |
| 11 | 19 29 | 21 38 | 23 25 | 1 18 | 3 11 | 5 17 | 7 21 | 9 23 | 11 17 | 13 05 | 15 05 | 17 13 | 11 |
| 12 | 19 33 | 21 42 | 23 29 | 1 22 | 3 15 | 5 21 | 7 25 | 9 27 | 11 20 | 13 09 | 15 09 | 17 17 | 12 |
| 13 | 19 38 | 21 46 | 23 33 | 1 26 | 3 19 | 5 25 | 7 29 | 9 31 | 11 24 | 13 13 | 15 13 | 17 21 | 13 |
| 14 | 19 42 | 21 50 | 23 36 | 1 29 | 3 23 | 5 29 | 7 33 | 9 34 | 11 28 | 13 16 | 15 17 | 17 26 | 14 |
| 15 | 19 47 | 21 54 | 23 40 | 1 33 | 3 27 | 5 33 | 7 37 | 9 38 | 11 31 | 13 20 | 15 21 | 17 30 | 15 |
| 16 | 19 51 | 21 58 | 23 43 | 1 37 | 3 31 | 5 37 | 7 41 | 9 42 | 11 35 | 13 24 | 15 25 | 17 35 | 16 |
| 17 | 19 55 | 22 02 | 23 47 | 1 40 | 3 35 | 5 42 | 7 45 | 9 46 | 11 38 | 13 28 | 15 30 | 17 39 | 17 |
| 18 | 20 00 | 22 05 | 23 51 | 1 44 | 3 39 | 5 46 | 7 49 | 9 49 | 11 42 | 13 31 | 15 34 | 17 43 | 18 |
| 19 | 20 04 | 22 09 | 23 54 | 1 48 | 3 43 | 5 50 | 7 53 | 9 53 | 11 46 | 13 35 | 15 38 | 17 48 | 19 |
| 20 | 20 08 | 22 13 | 23 58 | 1 51 | 3 47 | 5 54 | 7 57 | 9 57 | 11 49 | 13 39 | 15 42 | 17 52 | 20 |
| 21 | 20 12 | 22 17 | 0 02 | 1 55 | 3 51 | 5 58 | 8 01 | 10 00 | 11 53 | 13 43 | 15 46 | 17 57 | 21 |
| 22 | 20 17 | 22 21 | 0 05 | 1 59 | 3 55 | 6 02 | 8 05 | 10 04 | 11 56 | 13 46 | 15 50 | 18 01 | 22 |
| 23 | 20 21 | 22 25 | 0 09 | 2 03 | 3 59 | 6 07 | 8 09 | 10 08 | 12 00 | 13 50 | 15 55 | 18 06 | 23 |
| 24 | 20 25 | 22 28 | 0 13 | 2 06 | 4 03 | 6 11 | 8 13 | 10 12 | 12 04 | 13 54 | 15 59 | 18 10 | 24 |
| 25 | 20 29 | 22 32 | 0 16 | 2 10 | 4 07 | 6 15 | 8 17 | 10 15 | 12 07 | 13 58 | 16 03 | 18 15 | 25 |
| 26 | 20 33 | 22 36 | 0 20 | 2 14 | 4 11 | 6 19 | 8 21 | 10 19 | 12 11 | 14 02 | 16 07 | 18 19 | 26 |
| 27 | 20 37 | 22 40 | 0 23 | 2 18 | 4 15 | 6 23 | 8 25 | 10 23 | 12 14 | 14 06 | 16 12 | 18 23 | 27 |
| 28 | 20 42 | 22 43 | 0 27 | 2 21 | 4 19 | 6 27 | 8 29 | 10 26 | 12 18 | 14 09 | 16 16 | 18 28 | 28 |
| 29 | 20 46 | 22 46 | 0 31 | 2 25 | 4 23 | 6 31 | 8 33 | 10 30 | 12 22 | 14 13 | 16 20 | 18 32 | 29 |
| 30 | 20 50 | | 0 34 | 2 29 | 4 27 | 6 36 | 8 37 | 10 33 | 12 25 | 14 17 | 16 25 | 18 37 | 30 |
| 31 | 20 54 | | 0 38 | | 4 31 | | 8 41 | 10 37 | | 14 21 | | 18 41 | 31 |

# TABLE XV.

## For correcting the OBSERVED ALTITUDE of a FIXED STAR to find the TRUE ALTITUDE.

| Obs. Alt. | Height of the Eye above the Sea, in feet. | | | | | | | | | | | | | | | Obs. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | |
| ° | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ° |
| 6 | 10.4 | 10.8 | 11.2 | 11.5 | 11.8 | 12.1 | 12.3 | 12.5 | 12.8 | 13.0 | 13.2 | 13.4 | 13.6 | 13.7 | 13.9 | 6 |
| 7 | 9.3 | 9.7 | 10.1 | 10.4 | 10.7 | 10.9 | 11.2 | 11.4 | 11.6 | 11.8 | 12.0 | 12.2 | 12.4 | 12.6 | 12.8 | 7 |
| 8 | 8.4 | 8.8 | 9.3 | 9.6 | 9.9 | 10.2 | 10.5 | 10.7 | 10.9 | 11.1 | 11.3 | 11.5 | 11.7 | 11.9 | 12.1 | 8 |
| 9 | 7.7 | 8.2 | 8.6 | 9.0 | 9.2 | 9.5 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.8 | 11.0 | 11.2 | 11.4 | 9 |
| 10 | 7.2 | 7.7 | 8.1 | 8.3 | 8.7 | 8.9 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.8 | 10 |
| 12 | 6.3 | 6.8 | 7.2 | 7.5 | 7.8 | 8.0 | 8.3 | 8.5 | 8.8 | 9.0 | 9.1 | 9.4 | 9.6 | 9.7 | 9.9 | 12 |
| 14 | 5.7 | 6.2 | 6.5 | 6.9 | 7.1 | 7.4 | 7.7 | 7.9 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.3 | 14 |
| 16 | 5.2 | 5.7 | 6.1 | 6.4 | 6.7 | 6.9 | 7.2 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.8 | 16 |
| 18 | 4.8 | 5.3 | 5.7 | 6.0 | 6.3 | 6.5 | 6.8 | 7.0 | 7.2 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 18 |
| 20 | 4.5 | 5.0 | 5.4 | 5.7 | 6.0 | 6.2 | 6.5 | 6.7 | 6.9 | 7.1 | 7.3 | 7.5 | 7.7 | 7.9 | 8.0 | 20 |
| 22 | 4.3 | 4.7 | 5.1 | 5.4 | 5.7 | 6.0 | 6.2 | 6.4 | 6.7 | 6.9 | 7.1 | 7.3 | 7.4 | 7.6 | 7.8 | 22 |
| 26 | 3.9 | 4.3 | 4.7 | 5.0 | 5.3 | 5.6 | 5.8 | 6.0 | 6.3 | 6.5 | 6.7 | 6.9 | 7.0 | 7.2 | 7.4 | 26 |
| 30 | 3.6 | 4.0 | 4.4 | 4.7 | 5.0 | 5.3 | 5.5 | 5.7 | 6.0 | 6.2 | 6.4 | 6.6 | 6.7 | 6.9 | 7.1 | 30 |
| 35 | 3.3 | 3.7 | 4.1 | 4.4 | 4.7 | 5.0 | 5.2 | 5.4 | 5.7 | 5.9 | 6.1 | 6.3 | 6.4 | 6.6 | 6.8 | 35 |
| 40 | 3.1 | 3.5 | 3.9 | 4.2 | 4.5 | 4.7 | 5.0 | 5.2 | 5.4 | 5.6 | 5.8 | 6.0 | 6.2 | 6.4 | 6.6 | 40 |
| 50 | 2.7 | 3.2 | 3.5 | 3.8 | 4.1 | 4.4 | 4.6 | 4.9 | 5.1 | 5.3 | 5.5 | 5.7 | 5.9 | 6.1 | 6.2 | 50 |
| 60 | 2.5 | 2.9 | 3.3 | 3.6 | 3.9 | 4.1 | 4.4 | 4.6 | 4.8 | 5.0 | 5.2 | 5.4 | 5.6 | 5.8 | 6.0 | 60 |
| 70 | 2.3 | 2.7 | 3.1 | 3.4 | 3.7 | 3.9 | 4.2 | 4.4 | 4.6 | 4.8 | 5.0 | 5.2 | 5.4 | 5.6 | 5.8 | 70 |
| 80 | 2.1 | 2.5 | 2.9 | 3.2 | 3.5 | 3.7 | 4.0 | 4.2 | 4.4 | 4.6 | 4.8 | 5.0 | 5.2 | 5.4 | 5.6 | 80 |
| 90 | 2.0 | 2.4 | 2.7 | 3.0 | 3.3 | 3.6 | 3.8 | 4.1 | 4.3 | 4.5 | 4.7 | 4.9 | 5.1 | 5.3 | 5.4 | 90 |

# TABLE XVI.

## For reducing the time of the Moon's Passage over the Meridian of Greenwich, to the time of its Passage over any other Meridian.

| Long. | Daily Variation of the Moon's passing the Meridian. | | | | | | | | | | | | | Time fr. Moon's Southing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40m. | 42m. | 44m. | 46m. | 48m. | 50m. | 52m. | 54m. | 56m. | 58m. | 60m. | 62m. | 64m. | 66m. | |
| ° | m | m | m | m | m | m | m | m | m | m | m | m | m | m | h. m. |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 0 |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 0 40 |
| 20 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 1 20 |
| 30 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 2 0 |
| 40 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 2 40 |
| 50 | 5 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 9 | 9 | 3 20 |
| 60 | 6 | 7 | 7 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 10 | 10 | 10 | 11 | 4 0 |
| 70 | 7 | 8 | 8 | 9 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 12 | 12 | 4 40 |
| 80 | 9 | 9 | 9 | 10 | 10 | 11 | 11 | 12 | 12 | 12 | 13 | 13 | 14 | 14 | 5 20 |
| 90 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 13 | 14 | 14 | 15 | 15 | 16 | 6 0 |
| 100 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 14 | 15 | 15 | 16 | 17 | 17 | 18 | 6 40 |
| 110 | 12 | 12 | 13 | 14 | 14 | 15 | 15 | 16 | 16 | 17 | 18 | 18 | 19 | 19 | 7 20 |
| 120 | 13 | 14 | 14 | 15 | 15 | 16 | 17 | 17 | 18 | 19 | 19 | 20 | 20 | 21 | 8 0 |
| 130 | 14 | 15 | 15 | 16 | 17 | 17 | 18 | 19 | 19 | 20 | 21 | 21 | 22 | 23 | 8 40 |
| 140 | 15 | 16 | 17 | 17 | 18 | 19 | 20 | 20 | 21 | 22 | 22 | 23 | 24 | 25 | 9 20 |
| 150 | 16 | 17 | 18 | 19 | 19 | 20 | 21 | 22 | 22 | 23 | 24 | 25 | 26 | 26 | 10 0 |
| 160 | 17 | 18 | 19 | 20 | 21 | 21 | 22 | 23 | 24 | 25 | 26 | 26 | 27 | 28 | 10 40 |
| 170 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 25 | 26 | 27 | 28 | 29 | 30 | 11 20 |
| 180 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 12 0 |

# TABLE XVI.*

## For finding the Time of High Water.

| Moon's Passage over Merid. | Moon's Semidiameter. | | | | | | | | | | | | | | Moon's Passage over Merid. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14′ 30″ | 14′ 45″ | 15′ 0″ | 15′ 15″ | 15′ 30″ | 15′ 45″ | 16′ 0″ | 16′ 15″ | 16′ 30″ | | | | | | |
| h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. |
| 0 0 | −0 4 | −0 3 | −0 2 | −0 1 | −0 0 | +0 1 | +0 2 | +0 3 | +0 5 | | | | | | 12 0 |
| 0 20 | −0 8 | −0 8 | −0 7 | −0 6 | −0 5 | −0 4 | −0 3 | −0 2 | −0 1 | | | | | | 12 20 |
| 0 40 | −0 12 | −0 12 | −0 11 | −0 11 | −0 10 | −0 10 | −0 9 | −0 9 | −0 8 | | | | | | 12 40 |
| 1 0 | −0 17 | −0 17 | −0 17 | −0 16 | −0 16 | −0 16 | −0 15 | −0 15 | −0 15 | | | | | | 13 0 |
| 1 20 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | | | | | | 13 20 |
| 1 40 | −0 27 | −0 27 | −0 27 | −0 28 | −0 28 | −0 28 | −0 29 | −0 29 | −0 29 | | | | | | 13 40 |
| 2 0 | −0 31 | −0 31 | −0 32 | −0 32 | −0 33 | −0 33 | −0 34 | −0 35 | −0 36 | | | | | | 14 0 |
| 2 20 | −0 36 | −0 36 | −0 37 | −0 38 | −0 39 | −0 40 | −0 41 | −0 42 | −0 43 | | | | | | 14 20 |
| 2 40 | −0 40 | −0 41 | −0 42 | −0 43 | −0 44 | −0 45 | −0 46 | −0 47 | −0 49 | | | | | | 14 40 |
| 3 0 | −0 44 | −0 45 | −0 47 | −0 48 | −0 49 | −0 51 | −0 52 | −0 54 | −0 56 | | | | | | 15 0 |
| 3 30 | −0 49 | −0 51 | −0 53 | −0 55 | −0 56 | −0 58 | −1 0 | −1 2 | −1 4 | | | | | | 15 30 |
| 4 0 | −0 55 | −0 57 | −0 59 | −1 0 | −1 2 | −1 5 | −1 7 | −1 10 | −1 12 | | | | | | 16 0 |
| 4 30 | −0 58 | −1 0 | −1 2 | −1 3 | −1 5 | −1 7 | −1 10 | −1 13 | −1 16 | | | | | | 16 30 |
| 5 0 | −1 0 | −1 2 | −1 4 | −1 6 | −1 8 | −1 10 | −1 13 | −1 16 | −1 19 | | | | | | 17 0 |
| 5 30 | −0 59 | −1 1 | −1 3 | −1 5 | −1 7 | −1 9 | −1 12 | −1 15 | −1 18 | | | | | | 17 30 |
| 6 0 | −0 55 | −0 56 | −0 58 | −1 0 | −1 2 | −1 4 | −1 6 | −1 9 | −1 12 | | | | | | 18 0 |
| 6 20 | −0 49 | −0 50 | −0 51 | −0 52 | −0 54 | −0 56 | −0 58 | −1 0 | −1 3 | | | | | | 18 20 |
| 6 40 | −0 43 | −0 44 | −0 45 | −0 46 | −0 47 | −0 48 | −0 49 | −0 51 | −0 53 | | | | | | 18 40 |
| 6 50 | −0 37 | −0 37 | −0 38 | −0 39 | −0 40 | −0 41 | −0 42 | −0 43 | −0 45 | | | | | | 18 50 |
| 7 0 | −0 32 | −0 32 | −0 33 | −0 33 | −0 34 | −0 34 | −0 35 | −0 36 | −0 37 | | | | | | 19 0 |
| 7 10 | −0 27 | −0 27 | −0 27 | −0 27 | −0 28 | −0 28 | −0 28 | −0 29 | −0 29 | | | | | | 19 10 |
| 7 20 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | −0 22 | | | | | | 19 20 |
| 7 30 | −0 16 | −0 16 | −0 16 | −0 15 | −0 15 | −0 15 | −0 14 | −0 14 | −0 14 | | | | | | 19 30 |
| 7 40 | −0 11 | −0 11 | −0 10 | −0 10 | −0 9 | −0 9 | −0 8 | −0 7 | −0 6 | | | | | | 19 40 |
| 7 50 | −0 6 | −0 6 | −0 5 | −0 4 | −0 3 | −0 2 | −0 1 | −0 0 | +0 2 | | | | | | 19 50 |
| 8 0 | −0 1 | −0 0 | +0 1 | +0 2 | +0 3 | +0 4 | +0 6 | +0 7 | +0 9 | | | | | | 20 0 |
| 8 20 | +0 5 | +0 6 | +0 7 | +0 9 | +0 11 | +0 13 | +0 15 | +0 17 | +0 19 | | | | | | 20 20 |
| 8 40 | +0 11 | +0 12 | +0 14 | +0 16 | +0 18 | +0 20 | +0 22 | +0 25 | +0 28 | | | | | | 20 40 |
| 9 0 | +0 14 | +0 16 | +0 18 | +0 20 | +0 22 | +0 24 | +0 26 | +0 29 | +0 32 | | | | | | 21 0 |
| 9 30 | +0 16 | +0 18 | +0 20 | +0 22 | +0 24 | +0 27 | +0 30 | +0 33 | +0 36 | | | | | | 21 30 |
| 10 0 | +0 15 | +0 17 | +0 19 | +0 21 | +0 23 | +0 25 | +0 27 | +0 30 | +0 34 | | | | | | 22 0 |
| 10 30 | +0 12 | +0 14 | +0 15 | +0 17 | +0 19 | +0 21 | +0 23 | +0 26 | +0 30 | | | | | | 22 30 |
| 11 0 | +0 7 | +0 8 | +0 10 | +0 12 | +0 14 | +0 16 | +0 18 | +0 20 | +0 23 | | | | | | 23 0 |
| 11 20 | +0 4 | +0 5 | +0 6 | +0 7 | +0 9 | +0 11 | +0 13 | +0 15 | +0 17 | | | | | | 23 20 |
| 11 40 | +0 0 | +0 1 | +0 2 | +0 3 | +0 5 | +0 7 | +0 8 | +0 10 | +0 12 | | | | | | 23 40 |
| 12 0 | −0 4 | −0 3 | −0 2 | −0 1 | −0 0 | +0 1 | +0 2 | +0 3 | +0 5 | | | | | | 24 0 |

## TABLE XVII.

### To find the LATITUDE by an Altitude of the POLAR STAR.

| R. A. Merid. | Corr. for 1835. | Corr. for 1845. | R. A. Merid. | Corr. for 1835. | Corr. for 1845. | R. A. Merid. | Corr. for 1835. | Corr. for 1845. | R. A. Merid. | Corr. for 1835. | Corr. for 1845. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| h. m. | ° ′ | ° ′ | h. m. | ° ′ | ° ′ | h. m. | ° ′ | ° ′ | h. m. | ° ′ | ° ′ |
| 0 0 | −1 31 | −1 28 | 6 45 | −0 7 | −0 7 | 12 0 | +1 31 | +1 28 | 18 45 | +0 7 | +0 7 |
| 0 20 | −1 32 | −1 29 | 6 50 | −0 4 | −0 5 | 12 20 | +1 32 | +1 29 | 18 50 | +0 4 | +0 5 |
| 0 40 | −1 33 | −1 30 | 6 55 | −0 2 | −0 3 | 12 40 | +1 33 | +1 30 | 18 55 | +0 2 | +0 3 |
| 1 0 | −1 34 | −1 31 | 7 0 | +0 0 | +0 1 | 13 0 | +1 34 | +1 31 | 19 0 | −0 0 | −0 1 |
| 1 20 | −1 34 | −1 31 | 7 5 | +0 2 | +0 2 | 13 20 | +1 34 | +1 31 | 19 5 | −0 2 | −0 2 |
| 1 40 | −1 33 | −1 30 | 7 10 | +0 4 | +0 3 | 13 40 | +1 33 | +1 30 | 19 10 | −0 4 | −0 3 |
| 2 0 | −1 31 | −1 28 | 7 15 | +0 6 | +0 5 | 14 0 | +1 31 | +1 28 | 19 15 | −0 6 | −0 5 |
| 2 10 | −1 30 | −1 27 | 7 20 | +0 8 | +0 7 | 14 10 | +1 30 | +1 27 | 19 20 | −0 8 | −0 7 |
| 2 20 | −1 28 | −1 26 | 7 25 | +0 10 | +0 9 | 14 20 | +1 28 | +1 26 | 19 25 | −0 10 | −0 9 |
| 2 30 | −1 27 | −1 25 | 7 30 | +0 12 | +0 11 | 14 30 | +1 27 | +1 25 | 19 30 | −0 12 | −0 11 |
| 2 40 | −1 25 | −1 23 | 7 35 | +0 14 | +0 13 | 14 40 | +1 25 | +1 23 | 19 35 | −0 14 | −0 13 |
| 2 50 | −1 24 | −1 21 | 7 40 | +0 16 | +0 15 | 14 50 | +1 24 | +1 21 | 19 40 | −0 16 | −0 15 |
| 3 0 | −1 22 | −1 19 | 7 45 | +0 18 | +0 17 | 15 0 | +1 22 | +1 19 | 19 45 | −0 18 | −0 17 |
| 3 10 | −1 19 | −1 17 | 7 50 | +0 20 | +0 19 | 15 10 | +1 19 | +1 17 | 19 50 | −0 20 | −0 19 |
| 3 20 | −1 17 | −1 15 | 7 55 | +0 22 | +0 20 | 15 20 | +1 17 | +1 15 | 19 55 | −0 22 | −0 20 |
| 3 30 | −1 15 | −1 13 | 8 0 | +0 24 | +0 22 | 15 30 | +1 15 | +1 13 | 20 0 | −0 24 | −0 22 |
| 3 40 | −1 12 | −1 10 | 8 5 | +0 26 | +0 24 | 15 40 | +1 12 | +1 10 | 20 5 | −0 26 | −0 24 |
| 3 50 | −1 10 | −1 8 | 8 10 | +0 28 | +0 26 | 15 50 | +1 10 | +1 8 | 20 10 | −0 28 | −0 26 |
| 4 0 | −1 7 | −1 5 | 8 15 | +0 30 | +0 28 | 16 0 | +1 7 | +1 5 | 20 15 | −0 30 | −0 28 |
| 4 10 | −1 4 | −1 2 | 8 20 | +0 32 | +0 30 | 16 10 | +1 4 | +1 2 | 20 20 | −0 32 | −0 30 |
| 4 20 | −1 1 | −0 59 | 8 25 | +0 34 | +0 32 | 16 20 | +1 1 | +0 59 | 20 25 | −0 34 | −0 32 |
| 4 30 | −0 58 | −0 56 | 8 30 | +0 36 | +0 34 | 16 30 | +0 58 | +0 56 | 20 30 | −0 36 | −0 34 |
| 4 40 | −0 54 | −0 53 | 8 35 | +0 38 | +0 36 | 16 40 | +0 54 | +0 53 | 20 35 | −0 38 | −0 36 |
| 4 50 | −0 51 | −0 50 | 8 40 | +0 39 | +0 37 | 16 50 | +0 51 | +0 50 | 20 40 | −0 39 | −0 37 |
| 4 55 | −0 49 | −0 48 | 8 45 | +0 41 | +0 39 | 16 55 | +0 49 | +0 48 | 20 45 | −0 41 | −0 39 |
| 5 0 | −0 47 | −0 47 | 8 50 | +0 43 | +0 41 | 17 0 | +0 47 | +0 47 | 20 50 | −0 43 | −0 41 |
| 5 5 | −0 46 | −0 45 | 8 55 | +0 45 | +0 43 | 17 5 | +0 46 | +0 45 | 20 55 | −0 45 | −0 43 |
| 5 10 | −0 44 | −0 43 | 9 0 | +0 47 | +0 44 | 17 10 | +0 44 | +0 43 | 21 0 | −0 47 | −0 44 |
| 5 20 | −0 40 | −0 40 | 9 10 | +0 50 | +0 48 | 17 20 | +0 40 | +0 40 | 21 10 | −0 50 | −0 48 |
| 5 25 | −0 38 | −0 38 | 9 20 | +0 54 | +0 51 | 17 25 | +0 38 | +0 38 | 21 20 | −0 54 | −0 51 |
| 5 30 | −0 36 | −0 36 | 9 30 | +0 57 | +0 54 | 17 30 | +0 36 | +0 36 | 21 30 | −0 57 | −0 54 |
| 5 35 | −0 34 | −0 34 | 9 40 | +1 0 | +0 58 | 17 35 | +0 34 | +0 34 | 21 40 | −1 0 | −0 58 |
| 5 40 | −0 32 | −0 32 | 9 50 | +1 3 | +1 1 | 17 40 | +0 32 | +0 32 | 21 50 | −1 3 | −1 1 |
| 5 45 | −0 31 | −0 30 | 10 0 | +1 6 | +1 3 | 17 45 | +0 31 | +0 30 | 22 0 | −1 6 | −1 3 |
| 5 50 | −0 29 | −0 28 | 10 10 | +1 9 | +1 6 | 17 50 | +0 29 | +0 28 | 22 10 | −1 9 | −1 6 |
| 5 55 | −0 27 | −0 27 | 10 20 | +1 12 | +1 9 | 17 55 | +0 27 | +0 27 | 22 20 | −1 12 | −1 9 |
| 6 0 | −0 24 | −0 24 | 10 30 | +1 14 | +1 11 | 18 0 | +0 24 | +0 24 | 22 30 | −1 14 | −1 11 |
| 6 5 | −0 23 | −0 23 | 10 40 | +1 17 | +1 14 | 18 5 | +0 23 | +0 23 | 22 40 | −1 17 | −1 14 |
| 6 10 | −0 21 | −0 21 | 10 50 | +1 19 | +1 16 | 18 10 | +0 21 | +0 21 | 22 50 | −1 19 | −1 16 |
| 6 15 | −0 19 | −0 19 | 11 0 | +1 21 | +1 18 | 18 15 | +0 19 | +0 19 | 23 0 | −1 21 | −1 18 |
| 6 20 | −0 17 | −0 17 | 11 10 | +1 23 | +1 20 | 18 20 | +0 17 | +0 17 | 23 10 | −1 23 | −1 20 |
| 6 25 | −0 15 | −0 15 | 11 20 | +1 25 | +1 22 | 18 25 | +0 15 | +0 15 | 23 20 | −1 25 | −1 22 |
| 6 30 | −0 13 | −0 13 | 11 30 | +1 27 | +1 24 | 18 30 | +0 13 | +0 13 | 23 30 | −1 27 | −1 24 |
| 6 35 | −0 11 | −0 11 | 11 40 | +1 28 | +1 25 | 18 35 | +0 11 | +0 11 | 23 40 | −1 28 | −1 25 |
| 6 40 | −0 9 | −0 9 | 11 50 | +1 30 | +1 26 | 18 40 | +0 9 | +0 9 | 23 50 | −1 30 | −1 26 |

## TABLE XVII.*

### Corrections of the Latitude deduced from the above Table—Additive.

| R. A. Merid. | APPROXIMATE LATITUDE. | | | | | | | | | | | | | | R. A. Merid. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0° | 10° | 20° | 30° | 35° | 40° | 45° | 50° | 55° | 60° | 65° | 70° | 75° | 80° | |
| h. m. | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | h. m. |
| 0 0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.3 | 0.4 | 0.6 | 2 0 |
| 1 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1 0 |
| 2 0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.3 | 0.4 | 0.6 | 24 0 |
| 4 0 | 0.0 | 0.1 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 | 0.9 | 1.1 | 1.3 | 1.6 | 2.0 | 2.8 | 4.4 | 22 0 |
| 5 0 | 0.0 | 0.2 | 0.4 | 0.6 | 0.7 | 0.9 | 1.1 | 1.3 | 1.6 | 1.9 | 2.2 | 2.9 | 3.9 | 6.0 | 21 0 |
| 6 0 | 0.0 | 0.2 | 0.5 | 0.7 | 0.9 | 1.1 | 1.3 | 1.5 | 1.9 | 2.3 | 2.9 | 3.6 | 4.8 | 7.4 | 20 0 |
| 7 0 | 0.0 | 0.2 | 0.5 | 0.8 | 1.0 | 1.2 | 1.4 | 1.7 | 2.1 | 2.5 | 3.1 | 3.9 | 5.2 | 8.0 | 19 0 |
| 8 0 | 0.0 | 0.2 | 0.5 | 0.7 | 0.9 | 1.1 | 1.3 | 1.5 | 1.9 | 2.3 | 2.9 | 3.6 | 4.8 | 7.4 | 18 0 |
| 9 0 | 0.0 | 0.2 | 0.4 | 0.6 | 0.7 | 0.9 | 1.1 | 1.3 | 1.6 | 1.9 | 2.2 | 2.9 | 3.9 | 6.0 | 17 0 |
| 11 0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.9 | 1.3 | 1.9 | 15 0 |
| 13 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 0 |

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# TABLE XVIII.

## Corrections of the Apparent Altitudes of the Sun and Stars.

| App. Alt. | Sun's Corr. | Star's Corr. | Diff. to 1′ | App. Alt. | Sun's Corr. | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ″ | ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ |
| 0 0 | 32 51 | 33 0 | 10.0 | 5 0 | 9 44 | 9 52 | 6 0 | 8 18 | 8 26 | 7 0 | 7 12 | 7 21 |
| 5 | 32 1 | 32 10 | 9.6 | 1 | 9 42 | 9 51 | 1 | 8 17 | 8 25 | 1 | 7 11 | 7 20 |
| 10 | 31 13 | 31 22 | 9.4 | 2 | 9 41 | 9 49 | 2 | 8 15 | 8 24 | 2 | 7 10 | 7 19 |
| 15 | 30 26 | 30 35 | 9.1 | 3 | 9 39 | 9 48 | 3 | 8 14 | 8 23 | 3 | 7 9 | 7 18 |
| 20 | 29 41 | 29 49 | 8.9 | 4 | 9 37 | 9 46 | 4 | 8 13 | 8 22 | 4 | 7 8 | 7 17 |
| 25 | 28 56 | 29 5 | 8.6 | 5 | 9 36 | 9 44 | 5 | 8 12 | 8 20 | 5 | 7 7 | 7 16 |
| 0 30 | 28 13 | 28 22 | 8.4 | 5 6 | 9 34 | 9 43 | 6 6 | 8 10 | 8 19 | 7 6 | 7 6 | 7 15 |
| 35 | 27 31 | 27 40 | 8.1 | 7 | 9 32 | 9 41 | 7 | 8 9 | 8 18 | 7 | 7 6 | 7 14 |
| 40 | 26 51 | 26 59 | 7.9 | 8 | 9 31 | 9 40 | 8 | 8 8 | 8 17 | 8 | 7 5 | 7 13 |
| 45 | 26 11 | 26 20 | 7.7 | 9 | 9 29 | 9 38 | 9 | 8 7 | 8 15 | 9 | 7 4 | 7 12 |
| 50 | 25 33 | 25 41 | 7.4 | 10 | 9 28 | 9 36 | 10 | 8 6 | 8 14 | 10 | 7 3 | 7 11 |
| 55 | 24 55 | 25 4 | 7.2 | 11 | 9 26 | 9 35 | 11 | 8 4 | 8 13 | 11 | 7 2 | 7 10 |
| 1 0 | 24 19 | 24 28 | 7.0 | 5 12 | 9 25 | 9 33 | 6 12 | 8 3 | 8 12 | 7 12 | 7 1 | 7 10 |
| 5 | 23 44 | 23 53 | 6.7 | 13 | 9 23 | 9 32 | 13 | 8 2 | 8 11 | 13 | 7 0 | 7 9 |
| 10 | 23 10 | 23 19 | 6.5 | 14 | 9 21 | 9 30 | 14 | 8 1 | 8 10 | 14 | 6 59 | 7 8 |
| 15 | 22 38 | 22 46 | 6.4 | 15 | 9 20 | 9 29 | 15 | 8 0 | 8 8 | 15 | 6 58 | 7 7 |
| 20 | 22 6 | 22 15 | 6.2 | 16 | 9 18 | 9 27 | 16 | 7 59 | 8 7 | 16 | 6 57 | 7 6 |
| 25 | 21 35 | 21 44 | 6.1 | 17 | 9 17 | 9 25 | 17 | 7 57 | 8 6 | 17 | 6 56 | 7 5 |
| 1 30 | 21 5 | 21 14 | 5.7 | 5 18 | 9 15 | 9 24 | 6 18 | 7 56 | 8 5 | 7 18 | 6 55 | 7 4 |
| 35 | 20 36 | 20 45 | 5.6 | 19 | 9 14 | 9 22 | 19 | 7 55 | 8 4 | 19 | 6 55 | 7 3 |
| 40 | 20 8 | 20 17 | 5.3 | 20 | 9 12 | 9 21 | 20 | 7 54 | 8 3 | 20 | 6 54 | 7 2 |
| 45 | 19 41 | 19 50 | 5.2 | 21 | 9 11 | 9 19 | 21 | 7 53 | 8 1 | 21 | 6 53 | 7 1 |
| 50 | 19 15 | 19 24 | 5.0 | 22 | 9 9 | 9 18 | 22 | 7 52 | 8 0 | 22 | 6 52 | 7 1 |
| 55 | 18 50 | 18 59 | 4.9 | 23 | 9 8 | 9 16 | 23 | 7 50 | 7 59 | 23 | 6 51 | 7 0 |
| 2 0 | 18 25 | 18 34 | 4.7 | 5 24 | 9 6 | 9 15 | 6 24 | 7 49 | 7 58 | 7 24 | 6 50 | 6 59 |
| 5 | 18 2 | 18 10 | 4.5 | 25 | 9 5 | 9 13 | 25 | 7 48 | 7 57 | 25 | 6 49 | 6 58 |
| 10 | 17 39 | 17 48 | 4.5 | 26 | 9 3 | 9 12 | 26 | 7 47 | 7 56 | 26 | 6 48 | 6 57 |
| 15 | 17 17 | 17 25 | 4.3 | 27 | 9 2 | 9 11 | 27 | 7 46 | 7 55 | 27 | 6 48 | 6 56 |
| 20 | 16 55 | 17 4 | 4.2 | 28 | 9 0 | 9 9 | 28 | 7 45 | 7 54 | 28 | 6 47 | 6 55 |
| 25 | 16 34 | 16 43 | 4.0 | 29 | 8 59 | 9 8 | 29 | 7 44 | 7 53 | 29 | 6 46 | 6 54 |
| 2 30 | 16 14 | 16 23 | 3.9 | 5 30 | 8 58 | 9 6 | 6 30 | 7 43 | 7 51 | 7 30 | 6 45 | 6 54 |
| 35 | 15 55 | 16 3 | 3.8 | 31 | 8 56 | 9 5 | 31 | 7 42 | 7 50 | 31 | 6 44 | 6 53 |
| 40 | 15 36 | 15 44 | 3.6 | 32 | 8 55 | 9 3 | 32 | 7 41 | 7 49 | 32 | 6 43 | 6 52 |
| 45 | 15 17 | 15 26 | 3.5 | 33 | 8 53 | 9 2 | 33 | 7 40 | 7 48 | 33 | 6 42 | 6 51 |
| 50 | 15 0 | 15 8 | 3.4 | 34 | 8 52 | 9 1 | 34 | 7 38 | 7 47 | 34 | 6 42 | 6 50 |
| 55 | 14 43 | 14 51 | 3.4 | 35 | 8 51 | 8 59 | 35 | 7 37 | 7 46 | 35 | 6 41 | 6 49 |
| 3 0 | 14 26 | 14 35 | 3.3 | 5 36 | 8 49 | 8 58 | 6 36 | 7 36 | 7 45 | 7 36 | 6 40 | 6 49 |
| 5 | 14 10 | 14 19 | 3.2 | 37 | 8 48 | 8 56 | 37 | 7 35 | 7 44 | 37 | 6 39 | 6 48 |
| 10 | 13 54 | 14 3 | 3.1 | 38 | 8 46 | 8 55 | 38 | 7 34 | 7 43 | 38 | 6 38 | 6 47 |
| 15 | 13 39 | 13 48 | 3.0 | 39 | 8 45 | 8 54 | 39 | 7 33 | 7 42 | 39 | 6 37 | 6 46 |
| 20 | 13 24 | 13 33 | 2.8 | 40 | 8 44 | 8 52 | 40 | 7 32 | 7 41 | 40 | 6 37 | 6 45 |
| 25 | 13 10 | 13 19 | 2.8 | 41 | 8 42 | 8 51 | 41 | 7 31 | 7 40 | 41 | 6 36 | 6 44 |
| 3 30 | 12 56 | 13 5 | 2.7 | 5 42 | 8 41 | 8 50 | 6 42 | 7 30 | 7 39 | 7 42 | 6 35 | 6 44 |
| 35 | 12 43 | 12 51 | 2.6 | 43 | 8 40 | 8 48 | 43 | 7 29 | 7 38 | 43 | 6 34 | 6 43 |
| 40 | 12 30 | 12 38 | 2.6 | 44 | 8 38 | 8 47 | 44 | 7 28 | 7 37 | 44 | 6 33 | 6 42 |
| 45 | 12 17 | 12 26 | 2.5 | 45 | 8 37 | 8 46 | 45 | 7 27 | 7 36 | 45 | 6 33 | 6 41 |
| 50 | 12 5 | 12 13 | 2.4 | 46 | 8 36 | 8 44 | 46 | 7 26 | 7 35 | 46 | 6 32 | 6 40 |
| 55 | 11 53 | 12 1 | 2.3 | 47 | 8 34 | 8 43 | 47 | 7 25 | 7 34 | 47 | 6 31 | 6 40 |
| 4 0 | 11 41 | 11 50 | 2.3 | 5 48 | 8 33 | 8 42 | 6 48 | 7 24 | 7 33 | 7 48 | 6 30 | 6 39 |
| 5 | 11 30 | 11 38 | 2.2 | 49 | 8 32 | 8 40 | 49 | 7 23 | 7 32 | 49 | 6 29 | 6 38 |
| 10 | 11 19 | 11 27 | 2.1 | 50 | 8 30 | 8 39 | 50 | 7 22 | 7 31 | 50 | 6 29 | 6 37 |
| 15 | 11 8 | 11 17 | 2.1 | 51 | 8 29 | 8 38 | 51 | 7 21 | 7 30 | 51 | 6 28 | 6 36 |
| 20 | 10 58 | 11 6 | 2.0 | 52 | 8 28 | 8 36 | 52 | 7 20 | 7 29 | 52 | 6 27 | 6 36 |
| 25 | 10 48 | 10 56 | 2.0 | 53 | 8 27 | 8 35 | 53 | 7 19 | 7 28 | 53 | 6 26 | 6 35 |
| 4 30 | 10 38 | 10 46 | 1.9 | 5 54 | 8 25 | 8 34 | 6 54 | 7 18 | 7 27 | 7 54 | 6 25 | 6 34 |
| 35 | 10 28 | 10 37 | 1.9 | 55 | 8 24 | 8 33 | 55 | 7 17 | 7 26 | 55 | 6 25 | 6 33 |
| 40 | 10 19 | 10 28 | 1.8 | 56 | 8 23 | 8 31 | 56 | 7 16 | 7 25 | 56 | 6 24 | 6 33 |
| 45 | 10 10 | 10 18 | 1.8 | 57 | 8 21 | 8 30 | 57 | 7 15 | 7 24 | 57 | 6 23 | 6 32 |
| 50 | 10 1 | 10 10 | 1.7 | 58 | 8 20 | 8 29 | 58 | 7 14 | 7 23 | 58 | 6 22 | 6 31 |
| 55 | 9 52 | 10 1 | 1.7 | 59 | 8 19 | 8 28 | 59 | 7 13 | 7 22 | 59 | 6 22 | 6 30 |

## Corrections of the Apparent Altitudes of the Sun and Stars.

| App. Alt. | Sun's Corr. | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ |
| 8 0 | 6 21 | 6 30 | 9 0 | 5 40 | 5 48 | 11 0 | 4 38 | 4 47 | 13 0 | 3 54 | 4 3 |
| 1 | 6 20 | 6 29 | 2 | 5 39 | 5 47 | 2 | 4 37 | 4 46 | 2 | 3 54 | 4 2 |
| 2 | 6 19 | 6 28 | 4 | 5 37 | 5 46 | 4 | 4 37 | 4 45 | 4 | 3 53 | 4 2 |
| 3 | 6 19 | 6 27 | 6 | 5 35 | 5 45 | 6 | 4 36 | 4 44 | 6 | 3 53 | 4 1 |
| 4 | 6 18 | 6 27 | 8 | 5 34 | 5 44 | 8 | 4 35 | 4 43 | 8 | 3 52 | 4 1 |
| 5 | 6 17 | 6 26 | 10 | 5 34 | 5 42 | 10 | 4 34 | 4 43 | 10 | 3 51 | 4 0 |
| 8 6 | 6 16 | 6 25 | 9 12 | 5 33 | 5 41 | 11 12 | 4 33 | 4 42 | 13 12 | 3 51 | 3 59 |
| 7 | 6 16 | 6 24 | 14 | 5 31 | 5 40 | 14 | 4 32 | 4 41 | 14 | 3 50 | 3 59 |
| 8 | 6 15 | 6 24 | 16 | 5 30 | 5 39 | 16 | 4 32 | 4 40 | 16 | 3 50 | 3 58 |
| 9 | 6 14 | 6 23 | 18 | 5 29 | 5 38 | 18 | 4 31 | 4 39 | 18 | 3 49 | 3 57 |
| 10 | 6 13 | 6 22 | 20 | 5 28 | 5 36 | 20 | 4 30 | 4 39 | 20 | 3 48 | 3 57 |
| 11 | 6 13 | 6 21 | 22 | 5 27 | 5 35 | 22 | 4 29 | 4 38 | 22 | 3 48 | 3 56 |
| 8 12 | 6 12 | 6 21 | 9 24 | 5 26 | 5 34 | 11 24 | 4 28 | 4 37 | 13 24 | 3 47 | 3 56 |
| 13 | 6 11 | 6 20 | 26 | 5 24 | 5 33 | 26 | 4 28 | 4 36 | 26 | 3 47 | 3 55 |
| 14 | 6 10 | 6 19 | 28 | 5 23 | 5 32 | 28 | 4 27 | 4 35 | 28 | 3 46 | 3 54 |
| 15 | 6 10 | 6 18 | 30 | 5 22 | 5 31 | 30 | 4 26 | 4 35 | 30 | 3 45 | 3 54 |
| 16 | 6 9 | 6 18 | 32 | 5 21 | 5 30 | 32 | 4 25 | 4 34 | 32 | 3 45 | 3 53 |
| 17 | 6 8 | 6 17 | 34 | 5 20 | 5 29 | 34 | 4 24 | 4 33 | 34 | 3 44 | 3 53 |
| 8 18 | 6 8 | 6 16 | 9 36 | 5 19 | 5 27 | 11 36 | 4 24 | 4 32 | 13 36 | 3 44 | 3 52 |
| 19 | 6 7 | 6 16 | 38 | 5 18 | 5 26 | 38 | 4 23 | 4 31 | 38 | 3 43 | 3 52 |
| 20 | 6 6 | 6 15 | 40 | 5 17 | 5 25 | 40 | 4 22 | 4 31 | 40 | 3 43 | 3 51 |
| 21 | 6 5 | 6 14 | 42 | 5 16 | 5 24 | 42 | 4 21 | 4 30 | 42 | 3 42 | 3 51 |
| 22 | 6 5 | 6 13 | 44 | 5 15 | 5 23 | 44 | 4 21 | 4 29 | 44 | 3 41 | 3 50 |
| 23 | 6 4 | 6 13 | 46 | 5 13 | 5 22 | 46 | 4 20 | 4 28 | 46 | 3 41 | 3 49 |
| 8 24 | 6 3 | 6 12 | 9 48 | 5 12 | 5 21 | 11 48 | 4 19 | 4 28 | 13 48 | 3 40 | 3 49 |
| 25 | 6 3 | 6 11 | 50 | 5 11 | 5 20 | 50 | 4 18 | 4 27 | 50 | 3 40 | 3 48 |
| 26 | 6 2 | 6 11 | 52 | 5 10 | 5 19 | 52 | 4 18 | 4 26 | 52 | 3 39 | 3 48 |
| 27 | 6 1 | 6 10 | 54 | 5 9 | 5 18 | 54 | 4 17 | 4 25 | 54 | 3 39 | 3 47 |
| 28 | 6 1 | 6 9 | 56 | 5 8 | 5 17 | 56 | 4 16 | 4 25 | 56 | 3 38 | 3 47 |
| 29 | 6 0 | 6 9 | 58 | 5 7 | 5 16 | 58 | 4 15 | 4 24 | 58 | 3 38 | 3 46 |
| 8 30 | 5 59 | 6 8 | 10 0 | 5 6 | 5 15 | 12 0 | 4 15 | 4 23 | 14 0 | 3 37 | 3 45 |
| 31 | 5 59 | 6 7 | 2 | 5 5 | 5 14 | 2 | 4 14 | 4 22 | 2 | 3 36 | 3 45 |
| 32 | 5 58 | 6 7 | 4 | 5 4 | 5 13 | 4 | 4 13 | 4 22 | 4 | 3 36 | 3 44 |
| 33 | 5 57 | 6 6 | 6 | 5 3 | 5 12 | 6 | 4 12 | 4 21 | 6 | 3 35 | 3 44 |
| 34 | 5 57 | 6 5 | 8 | 5 2 | 5 11 | 8 | 4 12 | 4 20 | 8 | 3 35 | 3 43 |
| 35 | 5 56 | 6 5 | 10 | 5 1 | 5 10 | 10 | 4 11 | 4 20 | 10 | 3 34 | 3 43 |
| 8 36 | 5 55 | 6 4 | 10 12 | 5 0 | 5 9 | 12 12 | 4 10 | 4 19 | 14 12 | 3 34 | 3 42 |
| 37 | 5 55 | 6 3 | 14 | 4 59 | 5 8 | 14 | 4 10 | 4 18 | 14 | 3 33 | 3 42 |
| 38 | 5 54 | 6 3 | 16 | 4 58 | 5 7 | 16 | 4 9 | 4 17 | 16 | 3 33 | 3 41 |
| 39 | 5 53 | 6 2 | 18 | 4 57 | 5 6 | 18 | 4 8 | 4 17 | 18 | 3 32 | 3 41 |
| 40 | 5 53 | 6 1 | 20 | 4 56 | 5 5 | 20 | 4 8 | 4 16 | 20 | 3 32 | 3 40 |
| 41 | 5 52 | 6 1 | 22 | 4 55 | 5 4 | 22 | 4 7 | 4 15 | 22 | 3 31 | 3 40 |
| 8 42 | 5 51 | 6 0 | 10 24 | 4 54 | 5 3 | 12 24 | 4 6 | 4 15 | 14 24 | 3 31 | 3 39 |
| 43 | 5 51 | 5 59 | 26 | 4 53 | 5 2 | 26 | 4 6 | 4 14 | 26 | 3 30 | 3 39 |
| 44 | 5 50 | 5 59 | 28 | 4 53 | 5 1 | 28 | 4 5 | 4 13 | 28 | 3 30 | 3 38 |
| 45 | 5 49 | 5 58 | 30 | 4 52 | 5 0 | 30 | 4 4 | 4 13 | 30 | 3 29 | 3 38 |
| 46 | 5 49 | 5 57 | 32 | 4 51 | 4 59 | 32 | 4 3 | 4 12 | 32 | 3 29 | 3 37 |
| 47 | 5 48 | 5 57 | 34 | 4 50 | 4 58 | 34 | 4 3 | 4 11 | 34 | 3 28 | 3 37 |
| 8 48 | 5 47 | 5 56 | 10 36 | 4 49 | 4 57 | 12 36 | 4 2 | 4 11 | 14 36 | 3 28 | 3 36 |
| 49 | 5 47 | 5 55 | 38 | 4 48 | 4 57 | 38 | 4 2 | 4 10 | 38 | 3 27 | 3 36 |
| 50 | 5 46 | 5 55 | 40 | 4 47 | 4 56 | 40 | 4 1 | 4 9 | 40 | 3 27 | 3 35 |
| 51 | 5 45 | 5 54 | 42 | 4 46 | 4 55 | 42 | 4 0 | 4 9 | 42 | 3 26 | 3 35 |
| 52 | 5 45 | 5 53 | 44 | 4 45 | 4 54 | 44 | 4 0 | 4 8 | 44 | 3 26 | 3 34 |
| 53 | 5 44 | 5 53 | 46 | 4 44 | 4 53 | 46 | 3 59 | 4 7 | 46 | 3 25 | 3 34 |
| 8 54 | 5 44 | 5 52 | 10 48 | 4 43 | 4 52 | 12 48 | 3 58 | 4 7 | 14 48 | 3 25 | 3 33 |
| 55 | 5 43 | 5 52 | 50 | 4 43 | 4 51 | 50 | 3 58 | 4 6 | 50 | 3 24 | 3 33 |
| 56 | 5 42 | 5 51 | 52 | 4 42 | 4 50 | 52 | 3 57 | 4 5 | 52 | 3 24 | 3 32 |
| 57 | 5 42 | 5 50 | 54 | 4 41 | 4 49 | 54 | 3 56 | 4 5 | 54 | 3 23 | 3 32 |
| 58 | 5 41 | 5 50 | 56 | 4 40 | 4 49 | 56 | 3 56 | 4 4 | 56 | 3 23 | 3 31 |
| 59 | 5 40 | 5 49 | 58 | 4 39 | 4 48 | 58 | 3 55 | 4 4 | 58 | 3 22 | 3 31 |

# TABLE XVIII.

## Corrections of the Apparent Altitudes of the Sun and Stars.

| App. Alt. | Sun's Corr | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. | App. Alt. | Sun's Corr. | Star's Corr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ | ° ′ | ′ ″ | ′ ″ |
| 15 0 | 3 22 | 3 30 | 20 0 | 2 27 | 2 35 | 30 0 | 1 31 | 1 38 | 50 0 | 0 42 | 0 48 |
| 5 | 3 21 | 3 29 | 10 | 2 26 | 2 34 | 20 | 1 30 | 1 37 | 30 | 0 41 | 0 47 |
| 10 | 3 19 | 3 28 | 20 | 2 25 | 2 33 | 40 | 1 28 | 1 36 | 51 0 | 0 41 | 0 46 |
| 15 | 3 18 | 3 27 | 30 | 2 23 | 2 31 | 31 0 | 1 27 | 1 35 | 30 | 0 40 | 0 45 |
| 20 | 3 17 | 3 26 | 40 | 2 22 | 2 30 | 20 | 1 26 | 1 33 | 52 0 | 0 39 | 0 44 |
| 25 | 3 16 | 3 24 | 50 | 2 21 | 2 29 | 40 | 1 25 | 1 32 | 30 | 0 38 | 0 44 |
| 15 30 | 3 15 | 3 23 | 21 0 | 2 19 | 2 27 | 32 0 | 1 24 | 1 31 | 53 0 | 0 38 | 0 43 |
| 35 | 3 14 | 3 22 | 10 | 2 18 | 2 26 | 20 | 1 22 | 1 30 | 30 | 0 37 | 0 42 |
| 40 | 3 13 | 3 21 | 20 | 2 17 | 2 25 | 40 | 1 21 | 1 29 | 54 0 | 0 36 | 0 41 |
| 45 | 3 11 | 3 20 | 30 | 2 16 | 2 24 | 33 0 | 1 20 | 1 27 | 30 | 0 36 | 0 41 |
| 50 | 3 10 | 3 19 | 40 | 2 14 | 2 23 | 20 | 1 19 | 1 26 | 55 0 | 0 35 | 0 40 |
| 55 | 3 9 | 3 18 | 50 | 2 13 | 2 21 | 40 | 1 18 | 1 25 | 30 | 0 34 | 0 39 |
| 16 0 | 3 8 | 3 17 | 22 0 | 2 12 | 2 20 | 34 0 | 1 17 | 1 24 | 56 0 | 0 34 | 0 38 |
| 5 | 3 7 | 3 16 | 10 | 2 11 | 2 19 | 20 | 1 16 | 1 23 | 30 | 0 33 | 0 38 |
| 10 | 3 6 | 3 15 | 20 | 2 10 | 2 18 | 40 | 1 15 | 1 22 | 57 0 | 0 32 | 0 37 |
| 15 | 3 5 | 3 14 | 30 | 2 9 | 2 17 | 35 0 | 1 14 | 1 21 | 30 | 0 32 | 0 36 |
| 20 | 3 4 | 3 13 | 40 | 2 8 | 2 16 | 20 | 1 13 | 1 20 | 58 0 | 0 31 | 0 36 |
| 25 | 3 3 | 3 12 | 50 | 2 7 | 2 15 | 40 | 1 12 | 1 19 | 30 | 0 30 | 0 35 |
| 16 30 | 3 2 | 3 11 | 23 0 | 2 6 | 2 14 | 36 0 | 1 11 | 1 18 | 59 0 | 0 30 | 0 34 |
| 35 | 3 1 | 3 10 | 10 | 2 4 | 2 13 | 20 | 1 10 | 1 17 | 30 | 0 29 | 0 34 |
| 40 | 3 0 | 3 9 | 20 | 2 3 | 2 11 | 40 | 1 9 | 1 16 | 60 0 | 0 29 | 0 33 |
| 45 | 2 59 | 3 8 | 30 | 2 2 | 2 10 | 37 0 | 1 9 | 1 15 | 30 | 0 28 | 0 32 |
| 50 | 2 58 | 3 7 | 40 | 2 1 | 2 9 | 20 | 1 8 | 1 15 | 61 0 | 0 27 | 0 32 |
| 55 | 2 57 | 3 6 | 50 | 2 0 | 2 8 | 40 | 1 7 | 1 14 | 30 | 0 27 | 0 31 |
| 17 0 | 2 56 | 3 5 | 24 0 | 1 59 | 2 7 | 38 0 | 1 6 | 1 13 | 62 0 | 0 26 | 0 30 |
| 5 | 2 55 | 3 4 | 10 | 1 58 | 2 6 | 20 | 1 5 | 1 12 | 30 | 0 26 | 0 30 |
| 10 | 2 54 | 3 3 | 20 | 1 57 | 2 5 | 40 | 1 4 | 1 11 | 63 0 | 0 25 | 0 29 |
| 15 | 2 54 | 3 2 | 30 | 1 57 | 2 4 | 39 0 | 1 3 | 1 10 | 30 | 0 24 | 0 28 |
| 20 | 2 53 | 3 1 | 40 | 1 56 | 2 4 | 20 | 1 3 | 1 9 | 64 0 | 0 24 | 0 28 |
| 25 | 2 52 | 3 0 | 50 | 1 55 | 2 3 | 40 | 1 2 | 1 9 | 30 | 0 23 | 0 27 |
| 17 30 | 2 51 | 2 59 | 25 0 | 1 54 | 2 2 | 40 0 | 1 1 | 1 8 | 65 0 | 0 23 | 0 27 |
| 35 | 2 50 | 2 58 | 10 | 1 53 | 2 1 | 20 | 1 0 | 1 7 | 30 | 0 22 | 0 26 |
| 40 | 2 49 | 2 57 | 20 | 1 52 | 2 0 | 40 | 0 59 | 1 6 | 66 0 | 0 22 | 0 25 |
| 45 | 2 48 | 2 56 | 30 | 1 51 | 1 59 | 41 0 | 0 59 | 1 5 | 30 | 0 21 | 0 25 |
| 50 | 2 47 | 2 56 | 40 | 1 50 | 1 58 | 20 | 0 58 | 1 5 | 67 0 | 0 21 | 0 24 |
| 55 | 2 46 | 2 55 | 50 | 1 49 | 1 57 | 40 | 0 57 | 1 4 | 30 | 0 20 | 0 24 |
| 18 0 | 2 46 | 2 54 | 26 0 | 1 49 | 1 56 | 42 0 | 0 57 | 1 3 | 68 0 | 0 20 | 0 23 |
| 5 | 2 45 | 2 53 | 10 | 1 48 | 1 56 | 20 | 0 56 | 1 2 | 69 0 | 0 19 | 0 22 |
| 10 | 2 44 | 2 52 | 20 | 1 47 | 1 55 | 40 | 0 55 | 1 2 | 70 0 | 0 18 | 0 21 |
| 15 | 2 43 | 2 51 | 30 | 1 46 | 1 54 | 43 0 | 0 55 | 1 1 | 71 0 | 0 17 | 0 20 |
| 20 | 2 42 | 2 51 | 40 | 1 45 | 1 53 | 20 | 0 54 | 1 0 | 72 0 | 0 16 | 0 18 |
| 25 | 2 41 | 2 50 | 50 | 1 44 | 1 52 | 40 | 0 53 | 1 0 | 73 0 | 0 15 | 0 17 |
| 18 30 | 2 41 | 2 49 | 27 0 | 1 44 | 1 51 | 44 0 | 0 53 | 0 59 | 74 0 | 0 14 | 0 16 |
| 35 | 2 40 | 2 48 | 10 | 1 43 | 1 51 | 20 | 0 52 | 0 58 | 75 0 | 0 13 | 0 15 |
| 40 | 2 39 | 2 47 | 20 | 1 42 | 1 50 | 40 | 0 51 | 0 58 | 76 0 | 0 12 | 0 14 |
| 45 | 2 38 | 2 47 | 30 | 1 41 | 1 49 | 45 0 | 0 51 | 0 57 | 77 0 | 0 11 | 0 13 |
| 50 | 2 38 | 2 46 | 40 | 1 41 | 1 48 | 20 | 0 50 | 0 56 | 78 0 | 0 10 | 0 12 |
| 55 | 2 37 | 2 45 | 50 | 1 40 | 1 48 | 40 | 0 49 | 0 56 | 79 0 | 0 9 | 0 11 |
| 19 0 | 2 36 | 2 44 | 28 0 | 1 39 | 1 47 | 46 0 | 0 49 | 0 55 | 80 0 | 0 8 | 0 10 |
| 5 | 2 35 | 2 44 | 10 | 1 38 | 1 46 | 20 | 0 48 | 0 54 | 81 0 | 0 8 | 0 9 |
| 10 | 2 35 | 2 43 | 20 | 1 38 | 1 45 | 40 | 0 48 | 0 54 | 82 0 | 0 7 | 0 8 |
| 15 | 2 34 | 2 42 | 30 | 1 37 | 1 45 | 47 0 | 0 47 | 0 53 | 83 0 | 0 6 | 0 7 |
| 20 | 2 33 | 2 41 | 40 | 1 36 | 1 44 | 20 | 0 47 | 0 52 | 84 0 | 0 5 | 0 6 |
| 25 | 2 32 | 2 41 | 50 | 1 35 | 1 43 | 40 | 0 46 | 0 52 | 85 0 | 0 4 | 0 5 |
| 19 30 | 2 32 | 2 40 | 29 0 | 1 35 | 1 42 | 48 0 | 0 45 | 0 51 | 86 0 | 0 3 | 0 4 |
| 35 | 2 31 | 2 39 | 10 | 1 34 | 1 42 | 20 | 0 45 | 0 51 | 87 0 | 0 3 | 0 3 |
| 40 | 2 30 | 2 38 | 20 | 1 33 | 1 41 | 40 | 0 44 | 0 50 | 88 0 | 0 2 | 0 2 |
| 45 | 2 29 | 2 38 | 30 | 1 33 | 1 40 | 49 0 | 0 44 | 0 49 | 89 0 | 0 1 | 0 1 |
| 50 | 2 29 | 2 37 | 40 | 1 32 | 1 40 | 20 | 0 43 | 0 49 | 90 0 | 0 0 | 0 0 |
| 55 | 2 28 | 2 36 | 50 | 1 31 | 1 39 | 40 | 0 43 | 0 48 | | | |

# TABLE XIX.

## FOR REDUCING LONGITUDE INTO TIME, AND THE CONTRARY.

| ° | h. m. | ° | h. m. | ° | h. m. | ° | h. m. | ° | h. m. | ° | h. m. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ′ | m. s. | ′ | m. s. | ′ | m. s. | ′ | m. s. | ′ | m. s. | ′ | m. s. |
| ″ | s. t. | ″ | s. t. | ″ | s. t. | ″ | s. t. | ″ | s. t. | ″ | s. t. |
| 1 | 0 4 | 31 | 2 4 | 61 | 4 4 | 91 | 6 4 | 121 | 8 4 | 151 | 10 4 |
| 2 | 0 8 | 32 | 2 8 | 62 | 4 8 | 92 | 6 8 | 122 | 8 8 | 152 | 10 8 |
| 3 | 0 12 | 33 | 2 12 | 63 | 4 12 | 93 | 6 12 | 123 | 8 12 | 153 | 10 12 |
| 4 | 0 16 | 34 | 2 16 | 64 | 4 16 | 94 | 6 16 | 124 | 8 16 | 154 | 10 16 |
| 5 | 0 20 | 35 | 2 20 | 65 | 4 20 | 95 | 6 20 | 125 | 8 20 | 155 | 10 20 |
| 6 | 0 24 | 36 | 2 24 | 66 | 4 24 | 96 | 6 24 | 126 | 8 24 | 156 | 10 24 |
| 7 | 0 28 | 37 | 2 28 | 67 | 4 28 | 97 | 6 28 | 127 | 8 28 | 157 | 10 28 |
| 8 | 0 32 | 38 | 2 32 | 68 | 4 32 | 98 | 6 32 | 128 | 8 32 | 158 | 10 32 |
| 9 | 0 36 | 39 | 2 36 | 69 | 4 36 | 99 | 6 36 | 129 | 8 36 | 159 | 10 36 |
| 10 | 0 40 | 40 | 2 40 | 70 | 4 40 | 100 | 6 40 | 130 | 8 40 | 160 | 10 40 |
| 11 | 0 44 | 41 | 2 44 | 71 | 4 44 | 101 | 6 44 | 131 | 8 44 | 161 | 10 44 |
| 12 | 0 48 | 42 | 2 48 | 72 | 4 48 | 102 | 6 48 | 132 | 8 48 | 162 | 10 48 |
| 13 | 0 52 | 43 | 2 52 | 73 | 4 52 | 103 | 6 52 | 133 | 8 52 | 163 | 10 52 |
| 14 | 0 56 | 44 | 2 56 | 74 | 4 56 | 104 | 6 56 | 134 | 8 56 | 164 | 10 56 |
| 15 | 1 0 | 45 | 3 0 | 75 | 5 0 | 105 | 7 0 | 135 | 9 0 | 165 | 11 0 |
| 16 | 1 4 | 46 | 3 4 | 76 | 5 4 | 106 | 7 4 | 136 | 9 4 | 166 | 11 4 |
| 17 | 1 8 | 47 | 3 8 | 77 | 5 8 | 107 | 7 8 | 137 | 9 8 | 167 | 11 8 |
| 18 | 1 12 | 48 | 3 12 | 78 | 5 12 | 108 | 7 12 | 138 | 9 12 | 168 | 11 12 |
| 19 | 1 16 | 49 | 3 16 | 79 | 5 16 | 109 | 7 16 | 139 | 9 16 | 169 | 11 16 |
| 20 | 1 20 | 50 | 3 20 | 80 | 5 20 | 110 | 7 20 | 140 | 9 20 | 170 | 11 20 |
| 21 | 1 24 | 51 | 3 24 | 81 | 5 24 | 111 | 7 24 | 141 | 9 24 | 171 | 11 24 |
| 22 | 1 28 | 52 | 3 28 | 82 | 5 28 | 112 | 7 28 | 142 | 9 28 | 172 | 11 28 |
| 23 | 1 32 | 53 | 3 32 | 83 | 5 32 | 113 | 7 32 | 143 | 9 32 | 173 | 11 32 |
| 24 | 1 36 | 54 | 3 36 | 84 | 5 36 | 114 | 7 36 | 144 | 9 36 | 174 | 11 36 |
| 25 | 1 40 | 55 | 3 40 | 85 | 5 40 | 115 | 7 40 | 145 | 9 40 | 175 | 11 40 |
| 26 | 1 44 | 56 | 3 44 | 86 | 5 44 | 116 | 7 44 | 146 | 9 44 | 176 | 11 44 |
| 27 | 1 48 | 57 | 3 48 | 87 | 5 48 | 117 | 7 48 | 147 | 9 48 | 177 | 11 48 |
| 28 | 1 52 | 58 | 3 52 | 88 | 5 52 | 118 | 7 52 | 148 | 9 52 | 178 | 11 52 |
| 29 | 1 56 | 59 | 3 56 | 89 | 5 56 | 119 | 7 56 | 149 | 9 56 | 179 | 11 56 |
| 30 | 2 0 | 60 | 4 0 | 90 | 6 0 | 120 | 8 0 | 150 | 10 0 | 180 | 12 0 |

# TABLE XX.

## FOR FINDING THE DISTANCE OF TERRESTRIAL OBJECTS AT SEA.

| Height in feet. | Dist. in miles. | Height in feet. | Dist. in miles. | Height in feet. | Dist. in miles. | Height in feet. | Dist. in miles. | Height in feet. | Dist. in miles. | Height in feet. | Dist. in miles. | Height in feet. | Dist. in miles. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.15 | 25 | 5.74 | 49 | 8.0 | 180 | 15.4 | 420 | 23.5 | 820 | 32.9 | 2500 | 57.4 |
| 2 | 1.62 | 26 | 5.86 | 50 | 8.1 | 190 | 15.8 | 430 | 23.8 | 840 | 33.3 | 2600 | 58.6 |
| 3 | 1.99 | 27 | 5.97 | 55 | 8.5 | 200 | 16.2 | 440 | 24.1 | 860 | 33.7 | 2700 | 59.7 |
| 4 | 2.30 | 28 | 6.08 | 60 | 8.9 | 210 | 16.6 | 450 | 24.4 | 880 | 34.1 | 2800 | 60.8 |
| 5 | 2.57 | 29 | 6.18 | 65 | 9.3 | 220 | 17.0 | 460 | 24.6 | 900 | 34.5 | 2900 | 61.8 |
| 6 | 2.81 | 30 | 6.30 | 70 | 9.6 | 230 | 17.4 | 470 | 24.9 | 920 | 34.8 | 3000 | 63.0 |
| 7 | 3.04 | 31 | 6.40 | 75 | 9.9 | 240 | 17.8 | 480 | 25.2 | 940 | 35.2 | 3100 | 64.0 |
| 8 | 3.25 | 32 | 6.50 | 80 | 10.3 | 250 | 18.2 | 490 | 25.4 | 960 | 35.6 | 3200 | 65.0 |
| 9 | 3.45 | 33 | 6.60 | 85 | 10.6 | 260 | 18.5 | 500 | 25.7 | 980 | 36.0 | 3300 | 66.0 |
| 10 | 3.63 | 34 | 6.70 | 90 | 10.9 | 270 | 18.9 | 520 | 26.2 | 1000 | 36.3 | 3400 | 67.0 |
| 11 | 3.81 | 35 | 6.80 | 95 | 11.2 | 280 | 19.2 | 540 | 26.7 | 1100 | 38.1 | 3500 | 68.0 |
| 12 | 3.98 | 36 | 6.90 | 100 | 11.5 | 290 | 19.6 | 560 | 27.2 | 1200 | 39.8 | 3600 | 69.0 |
| 13 | 4.14 | 37 | 6.99 | 105 | 11.8 | 300 | 19.9 | 580 | 27.7 | 1300 | 41.4 | 3700 | 69.9 |
| 14 | 4.30 | 38 | 7.09 | 110 | 12.1 | 310 | 20.2 | 600 | 28.1 | 1400 | 43.0 | 3800 | 70.9 |
| 15 | 4.45 | 39 | 7.17 | 115 | 12.3 | 320 | 20.6 | 620 | 28.6 | 1500 | 44.5 | 3900 | 71.7 |
| 16 | 4.60 | 40 | 7.27 | 120 | 12.6 | 330 | 20.9 | 640 | 29.1 | 1600 | 46.0 | 4000 | 72.7 |
| 17 | 4.73 | 41 | 7.36 | 125 | 12.8 | 340 | 21.2 | 660 | 29.5 | 1700 | 47.3 | 4100 | 73.6 |
| 18 | 4.87 | 42 | 7.44 | 130 | 13.1 | 350 | 21.5 | 680 | 30.0 | 1800 | 48.7 | 4200 | 74.4 |
| 19 | 5.01 | 43 | 7.54 | 135 | 13.3 | 360 | 21.8 | 700 | 30.4 | 1900 | 50.1 | 4300 | 75.4 |
| 20 | 5.14 | 44 | 7.62 | 140 | 13.6 | 370 | 22.1 | 720 | 30.8 | 2000 | 51.4 | 4400 | 76.2 |
| 21 | 5.26 | 45 | 7.70 | 145 | 13.8 | 380 | 22.4 | 740 | 31.2 | 2100 | 52.6 | 4500 | 77.0 |
| 22 | 5.39 | 46 | 7.79 | 150 | 14.1 | 390 | 22.7 | 760 | 31.7 | 2200 | 53.9 | 4700 | 78.8 |
| 23 | 5.51 | 47 | 7.88 | 160 | 14.5 | 400 | 23.0 | 780 | 32.1 | 2300 | 55.1 | 5000 | 81.2 |
| 24 | 5.62 | 48 | 7.96 | 170 | 15.0 | 410 | 23.3 | 800 | 32.5 | 2400 | 56.2 | 1 mile | 83.5 |

# TABLE XXI.

## For reducing the SUN'S DECLINATION to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.

| When Sun's dec. is increasing. | add in W. lon. / sub. in E. lon. | Add for Greenw. time. | When Sun's dec. is decreasing. | sub. in W. lon. / add in E. lon. | Sub. for Greenw. time. |
|---|---|---|---|---|---|

| Long. | SUN'S DECLINATION. | | | | | | | | | | | | Time fr. Noon. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0° | 2° | 4° | 6° | 8° | 9° | 10° | 11° | 12° | 13° | 14° | 15° | |
| 0° | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0h. 0m. |
| 3 | 0 12 | 0 12 | 0 12 | 0 11 | 0 11 | 0 11 | 0 11 | 0 11 | 0 10 | 0 10 | 0 9 | 0 9 | 0 12 |
| 6 | 0 24 | 0 24 | 0 24 | 0 23 | 0 23 | 0 22 | 0 22 | 0 21 | 0 20 | 0 20 | 0 18 | 0 18 | 0 24 |
| 9 | 0 35 | 0 35 | 0 35 | 0 34 | 0 34 | 0 33 | 0 32 | 0 32 | 0 31 | 0 30 | 0 28 | 0 27 | 0 36 |
| 12 | 0 47 | 0 47 | 0 47 | 0 46 | 0 45 | 0 44 | 0 43 | 0 42 | 0 41 | 0 40 | 0 38 | 0 37 | 0 48 |
| 15 | 0 59 | 0 59 | 0 58 | 0 57 | 0 56 | 0 55 | 0 54 | 0 53 | 0 51 | 0 50 | 0 48 | 0 46 | 1 0 |
| 18 | 1 11 | 1 10 | 1 10 | 1 9 | 1 7 | 1 6 | 1 5 | 1 3 | 1 1 | 1 0 | 0 58 | 0 55 | 1 12 |
| 21 | 1 22 | 1 22 | 1 22 | 1 21 | 1 18 | 1 17 | 1 16 | 1 14 | 1 12 | 1 9 | 1 7 | 1 5 | 1 24 |
| 24 | 1 34 | 1 34 | 1 33 | 1 32 | 1 29 | 1 28 | 1 27 | 1 24 | 1 22 | 1 19 | 1 17 | 1 14 | 1 36 |
| 27 | 1 46 | 1 45 | 1 44 | 1 43 | 1 41 | 1 39 | 1 38 | 1 35 | 1 32 | 1 29 | 1 27 | 1 23 | 1 48 |
| 30 | 1 58 | 1 57 | 1 56 | 1 54 | 1 51 | 1 49 | 1 48 | 1 45 | 1 43 | 1 39 | 1 36 | 1 32 | 2 0 |
| 33 | 2 10 | 2 10 | 2 8 | 2 6 | 2 3 | 2 1 | 1 59 | 1 55 | 1 53 | 1 49 | 1 46 | 1 42 | 2 12 |
| 36 | 2 22 | 2 21 | 2 19 | 2 17 | 2 14 | 2 12 | 2 10 | 2 6 | 2 3 | 1 59 | 1 56 | 1 51 | 2 24 |
| 39 | 2 33 | 2 32 | 2 31 | 2 29 | 2 25 | 2 23 | 2 20 | 2 16 | 2 14 | 2 9 | 2 5 | 2 1 | 2 36 |
| 42 | 2 45 | 2 44 | 2 43 | 2 40 | 2 36 | 2 34 | 2 31 | 2 27 | 2 24 | 2 19 | 2 15 | 2 10 | 2 48 |
| 45 | 2 57 | 2 56 | 2 54 | 2 51 | 2 47 | 2 44 | 2 41 | 2 38 | 2 34 | 2 29 | 2 24 | 2 19 | 3 0 |
| 48 | 3 9 | 3 8 | 3 6 | 3 3 | 2 59 | 2 55 | 2 52 | 2 49 | 2 44 | 2 39 | 2 34 | 2 28 | 3 12 |
| 51 | 3 20 | 3 19 | 3 18 | 3 15 | 3 10 | 3 6 | 3 3 | 3 0 | 2 55 | 2 49 | 2 44 | 2 38 | 3 24 |
| 54 | 3 32 | 3 31 | 3 30 | 3 26 | 3 21 | 3 17 | 3 14 | 3 10 | 3 5 | 2 59 | 2 53 | 2 47 | 3 36 |
| 57 | 3 43 | 3 42 | 3 41 | 3 37 | 3 32 | 3 28 | 3 25 | 3 21 | 3 15 | 3 9 | 3 3 | 2 56 | 3 48 |
| 60 | 3 55 | 3 54 | 3 52 | 3 48 | 3 43 | 3 39 | 3 35 | 3 31 | 3 25 | 3 19 | 3 13 | 3 5 | 4 0 |
| 63 | 4 7 | 4 6 | 4 4 | 4 0 | 3 54 | 3 50 | 3 46 | 3 42 | 3 35 | 3 29 | 3 22 | 3 14 | 4 12 |
| 66 | 4 19 | 4 18 | 4 16 | 4 12 | 4 5 | 4 1 | 3 57 | 3 52 | 3 46 | 3 39 | 3 32 | 3 23 | 4 24 |
| 69 | 4 31 | 4 30 | 4 27 | 4 23 | 4 16 | 4 12 | 4 8 | 4 3 | 3 56 | 3 49 | 3 42 | 3 32 | 4 36 |
| 72 | 4 43 | 4 42 | 4 39 | 4 34 | 4 27 | 4 23 | 4 19 | 4 13 | 4 6 | 3 59 | 3 51 | 3 41 | 4 48 |
| 75 | 4 54 | 4 53 | 4 50 | 4 45 | 4 38 | 4 34 | 4 29 | 4 23 | 4 16 | 4 9 | 4 1 | 3 51 | 5 0 |
| 78 | 5 6 | 5 5 | 5 2 | 4 57 | 4 50 | 4 45 | 4 40 | 4 34 | 4 27 | 4 19 | 4 11 | 4 0 | 5 12 |
| 81 | 5 18 | 5 17 | 5 14 | 5 9 | 5 1 | 4 56 | 4 51 | 4 44 | 4 37 | 4 29 | 4 20 | 4 9 | 5 24 |
| 84 | 5 30 | 5 28 | 5 26 | 5 20 | 5 12 | 5 7 | 5 2 | 4 55 | 4 47 | 4 39 | 4 30 | 4 18 | 5 36 |
| 87 | 5 41 | 5 40 | 5 37 | 5 31 | 5 23 | 5 18 | 5 13 | 5 5 | 4 58 | 4 49 | 4 40 | 4 27 | 5 48 |
| 90 | 5 53 | 5 52 | 5 48 | 5 42 | 5 34 | 5 29 | 5 23 | 5 16 | 5 8 | 4 59 | 4 49 | 4 37 | 6 0 |
| 93 | 6 5 | 6 4 | 6 0 | 5 54 | 5 46 | 5 41 | 5 34 | 5 27 | 5 18 | 5 9 | 4 59 | 4 46 | 6 12 |
| 96 | 6 17 | 6 15 | 6 12 | 6 6 | 5 57 | 5 52 | 5 45 | 5 37 | 5 28 | 5 19 | 5 9 | 4 55 | 6 24 |
| 99 | 6 28 | 6 27 | 6 23 | 6 17 | 6 8 | 6 3 | 5 56 | 5 48 | 5 39 | 5 29 | 5 18 | 5 5 | 6 36 |
| 102 | 6 40 | 6 39 | 6 35 | 6 28 | 6 19 | 6 14 | 6 7 | 5 58 | 5 49 | 5 39 | 5 28 | 5 14 | 6 48 |
| 105 | 6 52 | 6 51 | 6 46 | 6 39 | 6 30 | 6 24 | 6 17 | 6 9 | 5 59 | 5 49 | 5 37 | 5 23 | 7 0 |
| 108 | 7 4 | 7 2 | 6 58 | 6 51 | 6 41 | 6 35 | 6 28 | 6 19 | 6 9 | 5 59 | 5 47 | 5 32 | 7 12 |
| 111 | 7 15 | 7 14 | 7 10 | 7 3 | 6 52 | 6 46 | 6 39 | 6 30 | 6 20 | 6 9 | 5 56 | 5 42 | 7 24 |
| 114 | 7 27 | 7 26 | 7 22 | 7 15 | 7 3 | 6 57 | 6 50 | 6 40 | 6 30 | 6 19 | 6 6 | 5 51 | 7 36 |
| 117 | 7 39 | 7 37 | 7 33 | 7 26 | 7 14 | 7 8 | 7 1 | 6 51 | 6 40 | 6 29 | 6 15 | 6 1 | 7 48 |
| 120 | 7 51 | 7 49 | 7 44 | 7 37 | 7 25 | 7 18 | 7 11 | 7 1 | 6 51 | 6 39 | 6 25 | 6 10 | 8 0 |
| 123 | 8 3 | 8 1 | 7 56 | 7 49 | 7 37 | 7 29 | 7 22 | 7 12 | 7 1 | 6 49 | 6 35 | 6 19 | 8 12 |
| 126 | 8 14 | 8 13 | 8 8 | 8 0 | 7 48 | 7 40 | 7 33 | 7 22 | 7 11 | 6 59 | 6 44 | 6 28 | 8 24 |
| 129 | 8 26 | 8 24 | 8 20 | 8 11 | 7 59 | 7 51 | 7 43 | 7 33 | 7 22 | 7 9 | 6 54 | 6 37 | 8 36 |
| 132 | 8 38 | 8 36 | 8 31 | 8 22 | 8 10 | 8 2 | 7 54 | 7 43 | 7 32 | 7 18 | 7 4 | 6 46 | 8 48 |
| 135 | 8 50 | 8 48 | 8 42 | 8 33 | 8 21 | 8 13 | 8 4 | 7 54 | 7 42 | 7 28 | 7 13 | 6 56 | 9 0 |
| 138 | 9 1 | 8 59 | 8 54 | 8 45 | 8 33 | 8 24 | 8 15 | 8 5 | 7 52 | 7 38 | 7 23 | 7 5 | 9 12 |
| 141 | 9 13 | 9 11 | 9 6 | 8 57 | 8 44 | 8 35 | 8 26 | 8 15 | 8 3 | 7 48 | 7 33 | 7 14 | 9 24 |
| 144 | 9 25 | 9 23 | 9 18 | 9 8 | 8 55 | 8 46 | 8 37 | 8 26 | 8 13 | 7 58 | 7 42 | 7 23 | 9 36 |
| 147 | 9 37 | 9 35 | 9 29 | 9 19 | 9 6 | 8 57 | 8 48 | 8 36 | 8 23 | 8 8 | 7 52 | 7 32 | 9 48 |
| 150 | 9 48 | 9 45 | 9 40 | 9 30 | 9 17 | 9 8 | 8 58 | 8 47 | 8 33 | 8 18 | 8 2 | 7 42 | 10 0 |
| 153 | 10 0 | 9 57 | 9 52 | 9 42 | 9 28 | 9 19 | 9 9 | 8 57 | 8 43 | 8 28 | 8 12 | 7 51 | 10 12 |
| 156 | 10 12 | 10 9 | 10 4 | 9 54 | 9 39 | 9 30 | 9 20 | 9 8 | 8 54 | 8 38 | 8 21 | 8 0 | 10 24 |
| 159 | 10 24 | 10 21 | 10 16 | 10 5 | 9 50 | 9 41 | 9 31 | 9 18 | 9 4 | 8 48 | 8 31 | 8 10 | 10 36 |
| 162 | 10 36 | 10 33 | 10 27 | 10 16 | 10 1 | 9 52 | 9 42 | 9 29 | 9 14 | 8 58 | 8 41 | 8 19 | 10 48 |
| 165 | 10 47 | 10 44 | 10 38 | 10 27 | 10 12 | 10 3 | 9 52 | 9 39 | 9 24 | 9 8 | 8 50 | 8 28 | 11 0 |
| 168 | 10 59 | 10 56 | 10 50 | 10 39 | 10 24 | 10 14 | 10 3 | 9 50 | 9 35 | 9 18 | 9 0 | 8 38 | 11 12 |
| 171 | 11 11 | 11 8 | 11 2 | 10 51 | 10 35 | 10 25 | 10 14 | 10 0 | 9 45 | 9 28 | 9 10 | 8 47 | 11 24 |
| 174 | 11 23 | 11 20 | 11 14 | 11 3 | 10 46 | 10 36 | 10 25 | 10 11 | 9 55 | 9 38 | 9 19 | 8 57 | 11 36 |
| 177 | 11 34 | 11 31 | 11 25 | 11 14 | 10 57 | 10 47 | 10 36 | 10 21 | 10 6 | 9 48 | 9 29 | 9 6 | 11 48 |
| 180 | 11 46 | 11 43 | 11 37 | 11 25 | 11 8 | 10 58 | 10 46 | 10 32 | 10 16 | 9 58 | 9 38 | 9 15 | 12 0 |

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# TABLE XXI.

## For reducing the SUN'S DECLINATION to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.

When Sun's dec. is increasing. { add in W. lon. / sub. in E. lon. } Add for Greenw. time. ‖ When Sun's dec. is decreasing. { sub. in W. lon. / add. in E. lon. } Sub. for Greenw. time.

| Long. | SUN'S DECLINATION. | | | | | | | | | | | | | | | | | | Time fr. Noon. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16° | 17° | 18° | 19° | 19°30′ | 20° | 20°30′ | 21° | 21°30′ | 22° | 22°30′ | 23° | 23°15′ | 23°28′ | | | | | |
| 0° | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | 0′ 0″ | | | | | 0h 0m |
| 3 | 0 9 | 0 8 | 0 8 | 0 7 | 0 7 | 0 6 | 0 6 | 0 5 | 0 5 | 0 4 | 0 3 | 0 2 | 0 2 | 0 0 | | | | | 0 12 |
| 6 | 0 18 | 0 16 | 0 16 | 0 14 | 0 13 | 0 12 | 0 11 | 0 10 | 0 9 | 0 8 | 0 6 | 0 4 | 0 4 | 0 0 | | | | | 0 24 |
| 9 | 0 27 | 0 24 | 0 24 | 0 21 | 0 20 | 0 18 | 0 17 | 0 15 | 0 14 | 0 12 | 0 10 | 0 7 | 0 5 | 0 0 | | | | | 0 36 |
| 12 | 0 36 | 0 32 | 0 31 | 0 28 | 0 27 | 0 25 | 0 23 | 0 21 | 0 19 | 0 16 | 0 14 | 0 9 | 0 7 | 0 0 | | | | | 0 48 |
| 15 | 0 44 | 0 41 | 0 39 | 0 35 | 0 34 | 0 32 | 0 29 | 0 27 | 0 24 | 0 21 | 0 18 | 0 12 | 0 9 | 0 0 | | | | | 1 0 |
| 18 | 0 53 | 0 49 | 0 46 | 0 42 | 0 40 | 0 38 | 0 35 | 0 32 | 0 29 | 0 25 | 0 21 | 0 14 | 0 10 | 0 0 | | | | | 1 12 |
| 21 | 1 2 | 0 57 | 0 54 | 0 49 | 0 47 | 0 44 | 0 41 | 0 38 | 0 34 | 0 29 | 0 24 | 0 17 | 0 12 | 0 0 | | | | | 1 24 |
| 24 | 1 11 | 1 5 | 1 2 | 0 56 | 0 54 | 0 50 | 0 47 | 0 44 | 0 39 | 0 34 | 0 28 | 0 19 | 0 14 | 0 0 | | | | | 1 36 |
| 27 | 1 20 | 1 14 | 1 10 | 1 3 | 1 1 | 0 57 | 0 53 | 0 50 | 0 44 | 0 39 | 0 32 | 0 22 | 0 15 | 0 0 | | | | | 1 48 |
| 30 | 1 28 | 1 23 | 1 18 | 1 11 | 1 8 | 1 4 | 0 59 | 0 55 | 0 49 | 0 43 | 0 36 | 0 25 | 0 17 | 0 0 | | | | | 2 0 |
| 33 | 1 37 | 1 31 | 1 25 | 1 18 | 1 14 | 1 10 | 1 4 | 1 0 | 0 53 | 0 47 | 0 39 | 0 27 | 0 19 | 0 0 | | | | | 2 12 |
| 36 | 1 46 | 1 39 | 1 33 | 1 25 | 1 21 | 1 16 | 1 10 | 1 5 | 0 58 | 0 51 | 0 42 | 0 30 | 0 20 | 0 0 | | | | | 2 24 |
| 39 | 1 55 | 1 47 | 1 41 | 1 32 | 1 28 | 1 22 | 1 16 | 1 10 | 1 3 | 0 55 | 0 46 | 0 32 | 0 22 | 0 0 | | | | | 2 36 |
| 42 | 2 4 | 1 56 | 1 49 | 1 39 | 1 35 | 1 29 | 1 22 | 1 16 | 1 8 | 0 59 | 0 50 | 0 34 | 0 24 | 0 0 | | | | | 2 48 |
| 45 | 2 12 | 2 5 | 1 57 | 1 46 | 1 42 | 1 36 | 1 28 | 1 22 | 1 13 | 1 4 | 0 54 | 0 36 | 0 25 | 0 0 | | | | | 3 0 |
| 48 | 2 21 | 2 13 | 2 4 | 1 53 | 1 48 | 1 42 | 1 33 | 1 27 | 1 18 | 1 8 | 0 57 | 0 39 | 0 27 | 0 0 | | | | | 3 12 |
| 51 | 2 30 | 2 21 | 2 12 | 2 0 | 1 55 | 1 48 | 1 39 | 1 32 | 1 23 | 1 12 | 1 0 | 0 42 | 0 29 | 0 0 | | | | | 3 24 |
| 54 | 2 39 | 2 29 | 2 20 | 2 7 | 2 2 | 1 54 | 1 45 | 1 38 | 1 28 | 1 16 | 1 3 | 0 44 | 0 30 | 0 0 | | | | | 3 36 |
| 57 | 2 48 | 2 38 | 2 28 | 2 15 | 2 9 | 2 1 | 1 52 | 1 44 | 1 33 | 1 21 | 1 7 | 0 47 | 0 32 | 0 0 | | | | | 3 48 |
| 60 | 2 56 | 2 47 | 2 36 | 2 23 | 2 16 | 2 8 | 1 59 | 1 49 | 1 39 | 1 26 | 1 11 | 0 49 | 0 34 | 0 0 | | | | | 4 0 |
| 63 | 3 5 | 2 55 | 2 43 | 2 29 | 2 22 | 2 14 | 2 4 | 1 54 | 1 43 | 1 30 | 1 14 | 0 51 | 0 35 | 0 0 | | | | | 4 12 |
| 66 | 3 14 | 3 2 | 2 51 | 2 36 | 2 29 | 2 20 | 2 10 | 1 59 | 1 48 | 1 34 | 1 17 | 0 54 | 0 37 | 0 0 | | | | | 4 24 |
| 69 | 3 23 | 3 11 | 2 59 | 2 43 | 2 36 | 2 26 | 2 16 | 2 4 | 1 53 | 1 38 | 1 21 | 0 56 | 0 39 | 0 0 | | | | | 4 36 |
| 72 | 3 32 | 3 19 | 3 7 | 2 50 | 2 43 | 2 33 | 2 21 | 2 10 | 1 58 | 1 42 | 1 25 | 0 59 | 0 40 | 0 0 | | | | | 4 48 |
| 75 | 3 40 | 3 28 | 3 15 | 2 58 | 2 50 | 2 40 | 2 27 | 2 16 | 2 3 | 1 47 | 1 29 | 1 1 | 0 42 | 0 0 | | | | | 5 0 |
| 78 | 3 49 | 3 36 | 3 22 | 3 5 | 2 56 | 2 46 | 2 33 | 2 21 | 2 8 | 1 51 | 1 32 | 1 4 | 0 44 | 0 0 | | | | | 5 12 |
| 81 | 3 58 | 3 44 | 3 30 | 3 12 | 3 3 | 2 53 | 2 39 | 2 26 | 2 13 | 1 55 | 1 35 | 1 6 | 0 45 | 0 0 | | | | | 5 24 |
| 84 | 4 7 | 3 52 | 3 38 | 3 19 | 3 10 | 2 58 | 2 45 | 2 32 | 2 18 | 1 59 | 1 39 | 1 9 | 0 47 | 0 0 | | | | | 5 36 |
| 87 | 4 16 | 4 1 | 3 46 | 3 26 | 3 17 | 3 5 | 2 52 | 2 38 | 2 23 | 2 4 | 1 43 | 1 11 | 0 49 | 0 0 | | | | | 5 48 |
| 90 | 4 25 | 4 10 | 3 54 | 3 34 | 3 24 | 3 12 | 2 59 | 2 44 | 2 28 | 2 9 | 1 47 | 1 14 | 0 50 | 0 0 | | | | | 6 0 |
| 93 | 4 34 | 4 18 | 4 1 | 3 41 | 3 30 | 3 18 | 3 4 | 2 49 | 2 32 | 2 13 | 1 50 | 1 16 | 0 52 | 0 0 | | | | | 6 12 |
| 96 | 4 43 | 4 26 | 4 9 | 3 48 | 3 37 | 3 24 | 3 9 | 2 54 | 2 37 | 2 17 | 1 53 | 1 19 | 0 54 | 0 0 | | | | | 6 24 |
| 99 | 4 52 | 4 34 | 4 17 | 3 55 | 3 44 | 3 30 | 3 15 | 2 59 | 2 42 | 2 21 | 1 57 | 1 21 | 0 55 | 0 0 | | | | | 6 36 |
| 102 | 5 0 | 4 43 | 4 25 | 4 2 | 3 51 | 3 37 | 3 21 | 3 5 | 2 47 | 2 25 | 2 1 | 1 24 | 0 57 | 0 0 | | | | | 6 48 |
| 105 | 5 8 | 4 52 | 4 33 | 4 9 | 3 58 | 3 44 | 3 27 | 3 11 | 2 52 | 2 30 | 2 5 | 1 26 | 0 59 | 0 0 | | | | | 7 0 |
| 108 | 5 17 | 5 0 | 4 40 | 4 16 | 4 4 | 3 50 | 3 33 | 3 16 | 2 57 | 2 34 | 2 9 | 1 29 | 1 0 | 0 0 | | | | | 7 12 |
| 111 | 5 26 | 5 8 | 4 48 | 4 23 | 4 11 | 3 56 | 3 39 | 3 21 | 3 2 | 2 38 | 2 12 | 1 31 | 1 2 | 0 0 | | | | | 7 24 |
| 114 | 5 35 | 5 16 | 4 56 | 4 30 | 4 18 | 4 2 | 3 46 | 3 27 | 3 7 | 2 43 | 2 16 | 1 34 | 1 4 | 0 0 | | | | | 7 36 |
| 117 | 5 44 | 5 25 | 5 4 | 4 38 | 4 25 | 4 9 | 3 52 | 3 33 | 3 12 | 2 48 | 2 20 | 1 37 | 1 5 | 0 0 | | | | | 7 48 |
| 120 | 5 53 | 5 34 | 5 12 | 4 46 | 4 32 | 4 16 | 3 59 | 3 39 | 3 17 | 2 53 | 2 23 | 1 39 | 1 7 | 0 0 | | | | | 8 0 |
| 123 | 6 2 | 5 42 | 5 19 | 4 53 | 4 38 | 4 22 | 4 4 | 3 44 | 3 22 | 2 57 | 2 26 | 1 41 | 1 9 | 0 0 | | | | | 8 12 |
| 126 | 6 11 | 5 50 | 5 27 | 5 0 | 4 45 | 4 28 | 4 10 | 3 49 | 3 27 | 3 1 | 2 29 | 1 44 | 1 10 | 0 0 | | | | | 8 24 |
| 129 | 6 19 | 5 58 | 5 35 | 5 7 | 4 52 | 4 34 | 4 16 | 3 54 | 3 32 | 3 5 | 2 33 | 1 46 | 1 12 | 0 0 | | | | | 8 36 |
| 132 | 6 28 | 6 6 | 5 43 | 5 14 | 4 59 | 4 41 | 4 22 | 3 59 | 3 37 | 3 9 | 2 36 | 1 49 | 1 14 | 0 0 | | | | | 8 48 |
| 135 | 6 36 | 6 15 | 5 51 | 5 21 | 5 6 | 4 48 | 4 28 | 4 5 | 3 42 | 3 13 | 2 40 | 1 51 | 1 15 | 0 0 | | | | | 9 0 |
| 138 | 6 45 | 6 23 | 5 58 | 5 28 | 5 12 | 4 54 | 4 34 | 4 10 | 3 47 | 3 17 | 2 43 | 1 54 | 1 17 | 0 0 | | | | | 9 12 |
| 141 | 6 54 | 6 31 | 6 6 | 5 35 | 5 19 | 5 0 | 4 40 | 4 15 | 3 52 | 3 21 | 2 46 | 1 56 | 1 19 | 0 0 | | | | | 9 24 |
| 144 | 7 3 | 6 39 | 6 14 | 5 42 | 5 26 | 5 6 | 4 46 | 4 21 | 3 57 | 3 26 | 2 50 | 1 59 | 1 20 | 0 0 | | | | | 9 36 |
| 147 | 7 12 | 6 48 | 6 22 | 5 49 | 5 33 | 5 13 | 4 52 | 4 27 | 4 2 | 3 30 | 2 54 | 2 1 | 1 22 | 0 0 | | | | | 9 48 |
| 150 | 7 21 | 6 57 | 6 30 | 5 57 | 5 40 | 5 20 | 4 58 | 4 33 | 4 7 | 3 35 | 2 58 | 2 4 | 1 24 | 0 0 | | | | | 10 0 |
| 153 | 7 30 | 7 5 | 6 37 | 6 4 | 5 46 | 5 26 | 5 3 | 4 38 | 4 11 | 3 39 | 3 1 | 2 6 | 1 25 | 0 0 | | | | | 10 12 |
| 156 | 7 39 | 7 13 | 6 45 | 6 11 | 5 53 | 5 32 | 5 9 | 4 43 | 4 16 | 3 43 | 3 4 | 2 9 | 1 27 | 0 0 | | | | | 10 24 |
| 159 | 7 48 | 7 21 | 6 53 | 6 18 | 6 0 | 5 38 | 5 15 | 4 48 | 4 21 | 3 47 | 3 8 | 2 11 | 1 29 | 0 0 | | | | | 10 36 |
| 162 | 7 57 | 7 29 | 7 1 | 6 25 | 6 7 | 5 45 | 5 21 | 4 54 | 4 26 | 3 51 | 3 12 | 2 13 | 1 30 | 0 0 | | | | | 10 48 |
| 165 | 8 5 | 7 38 | 7 9 | 6 32 | 6 14 | 5 52 | 5 26 | 5 0 | 4 31 | 3 56 | 3 16 | 2 15 | 1 32 | 0 0 | | | | | 11 0 |
| 168 | 8 14 | 7 46 | 7 16 | 6 39 | 6 20 | 5 58 | 5 32 | 5 6 | 4 36 | 4 0 | 3 19 | 2 17 | 1 34 | 0 0 | | | | | 11 12 |
| 171 | 8 23 | 7 54 | 7 24 | 6 46 | 6 27 | 6 4 | 5 38 | 5 11 | 4 41 | 4 4 | 3 22 | 2 20 | 1 35 | 0 0 | | | | | 11 24 |
| 174 | 8 32 | 8 3 | 7 32 | 6 53 | 6 34 | 6 10 | 5 44 | 5 17 | 4 46 | 4 9 | 3 26 | 2 22 | 1 37 | 0 0 | | | | | 11 36 |
| 177 | 8 41 | 8 12 | 7 40 | 7 1 | 6 41 | 6 17 | 5 51 | 5 23 | 4 51 | 4 14 | 3 30 | 2 25 | 1 39 | 0 0 | | | | | 11 48 |
| 180 | 8 49 | 8 21 | 7 48 | 7 9 | 6 48 | 6 24 | 5 58 | 5 29 | 4 56 | 4 19 | 3 34 | 2 28 | 1 40 | 0 0 | | | | | 12 0 |

# TABLE XXII.

## For reducing the SUN'S RIGHT ASCENSION to any Time at the Meridian of Greenwich.

| Time fr. Noon. | SUN'S RIGHT ASCENSION. | | | | | | | | | | | | | | | | | | | | | | | | Time fr. Noon. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 h. | | 1 h. | | 2 h. | | 3 h. | | 4 h. | | 5 h. | | 6 h. | | 7 h. | | 8 h. | | 9 h. | | 10 h. | | 11 h. | | |
| h. m. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | m. | s. | h. m. |
| 0 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 0 |
| 0 12 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 12 |
| 0 24 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 24 |
| 0 36 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 5 | 0 36 |
| 0 48 | 0 | 7 | 0 | 7 | 0 | 7 | 0 | 8 | 0 | 8 | 0 | 8 | 0 | 8 | 0 | 8 | 0 | 8 | 0 | 8 | 0 | 7 | 0 | 7 | 0 48 |
| 1 0 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 9 | 0 | 9 | 1 0 |
| 1 12 | 0 | 11 | 0 | 11 | 0 | 11 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 11 | 0 | 11 | 1 12 |
| 1 24 | 0 | 13 | 0 | 13 | 0 | 13 | 0 | 14 | 0 | 14 | 0 | 14 | 0 | 14 | 0 | 14 | 0 | 14 | 0 | 13 | 0 | 13 | 0 | 13 | 1 24 |
| 1 36 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 16 | 0 | 16 | 0 | 17 | 0 | 16 | 0 | 16 | 0 | 15 | 0 | 15 | 0 | 14 | 1 36 |
| 1 48 | 0 | 16 | 0 | 16 | 0 | 17 | 0 | 17 | 0 | 18 | 0 | 18 | 0 | 19 | 0 | 18 | 0 | 18 | 0 | 17 | 0 | 17 | 0 | 16 | 1 48 |
| 2 0 | 0 | 18 | 0 | 18 | 0 | 19 | 0 | 19 | 0 | 20 | 0 | 21 | 0 | 21 | 0 | 21 | 0 | 20 | 0 | 19 | 0 | 18 | 0 | 18 | 2 0 |
| 2 12 | 0 | 20 | 0 | 20 | 0 | 21 | 0 | 21 | 0 | 22 | 0 | 23 | 0 | 23 | 0 | 23 | 0 | 22 | 0 | 21 | 0 | 20 | 0 | 20 | 2 12 |
| 2 24 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 23 | 0 | 24 | 0 | 25 | 0 | 25 | 0 | 25 | 0 | 24 | 0 | 23 | 0 | 22 | 0 | 22 | 2 24 |
| 2 36 | 0 | 24 | 0 | 24 | 0 | 24 | 0 | 25 | 0 | 26 | 0 | 27 | 0 | 27 | 0 | 27 | 0 | 26 | 0 | 25 | 0 | 24 | 0 | 23 | 2 36 |
| 2 48 | 0 | 25 | 0 | 25 | 0 | 26 | 0 | 27 | 0 | 28 | 0 | 29 | 0 | 29 | 0 | 29 | 0 | 28 | 0 | 27 | 0 | 26 | 0 | 25 | 2 48 |
| 3 0 | 0 | 27 | 0 | 27 | 0 | 28 | 0 | 29 | 0 | 30 | 0 | 31 | 0 | 31 | 0 | 31 | 0 | 30 | 0 | 29 | 0 | 28 | 0 | 27 | 3 0 |
| 3 12 | 0 | 29 | 0 | 29 | 0 | 30 | 0 | 31 | 0 | 32 | 0 | 33 | 0 | 33 | 0 | 33 | 0 | 32 | 0 | 31 | 0 | 30 | 0 | 29 | 3 12 |
| 3 24 | 0 | 31 | 0 | 31 | 0 | 32 | 0 | 33 | 0 | 34 | 0 | 35 | 0 | 35 | 0 | 35 | 0 | 34 | 0 | 33 | 0 | 32 | 0 | 31 | 3 24 |
| 3 36 | 0 | 33 | 0 | 33 | 0 | 34 | 0 | 35 | 0 | 36 | 0 | 37 | 0 | 37 | 0 | 37 | 0 | 36 | 0 | 35 | 0 | 33 | 0 | 32 | 3 36 |
| 3 48 | 0 | 35 | 0 | 35 | 0 | 36 | 0 | 37 | 0 | 38 | 0 | 39 | 0 | 39 | 0 | 39 | 0 | 38 | 0 | 36 | 0 | 35 | 0 | 34 | 3 48 |
| 4 0 | 0 | 36 | 0 | 36 | 0 | 37 | 0 | 39 | 0 | 40 | 0 | 41 | 0 | 42 | 0 | 41 | 0 | 40 | 0 | 38 | 0 | 37 | 0 | 36 | 4 0 |
| 4 12 | 0 | 38 | 0 | 38 | 0 | 39 | 0 | 41 | 0 | 42 | 0 | 43 | 0 | 44 | 0 | 43 | 0 | 42 | 0 | 40 | 0 | 39 | 0 | 38 | 4 12 |
| 4 24 | 0 | 40 | 0 | 40 | 0 | 41 | 0 | 43 | 0 | 44 | 0 | 45 | 0 | 46 | 0 | 45 | 0 | 44 | 0 | 42 | 0 | 41 | 0 | 40 | 4 24 |
| 4 36 | 0 | 42 | 0 | 42 | 0 | 43 | 0 | 45 | 0 | 46 | 0 | 47 | 0 | 48 | 0 | 47 | 0 | 46 | 0 | 44 | 0 | 42 | 0 | 41 | 4 36 |
| 4 48 | 0 | 44 | 0 | 44 | 0 | 45 | 0 | 46 | 0 | 48 | 0 | 49 | 0 | 50 | 0 | 49 | 0 | 48 | 0 | 46 | 0 | 44 | 0 | 43 | 4 48 |
| 5 0 | 0 | 45 | 0 | 46 | 0 | 47 | 0 | 48 | 0 | 50 | 0 | 51 | 0 | 52 | 0 | 51 | 0 | 50 | 0 | 48 | 0 | 46 | 0 | 45 | 5 0 |
| 5 12 | 0 | 47 | 0 | 47 | 0 | 49 | 0 | 50 | 0 | 52 | 0 | 54 | 0 | 54 | 0 | 53 | 0 | 52 | 0 | 50 | 0 | 48 | 0 | 47 | 5 12 |
| 5 24 | 0 | 49 | 0 | 49 | 0 | 50 | 0 | 52 | 0 | 54 | 0 | 56 | 0 | 56 | 0 | 55 | 0 | 54 | 0 | 52 | 0 | 50 | 0 | 49 | 5 24 |
| 5 36 | 0 | 51 | 0 | 51 | 0 | 52 | 0 | 54 | 0 | 56 | 0 | 58 | 0 | 58 | 0 | 58 | 0 | 56 | 0 | 54 | 0 | 52 | 0 | 50 | 5 36 |
| 5 48 | 0 | 53 | 0 | 53 | 0 | 54 | 0 | 56 | 0 | 58 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 58 | 0 | 56 | 0 | 54 | 0 | 52 | 5 48 |
| 6 0 | 0 | 54 | 0 | 55 | 0 | 56 | 0 | 58 | 1 | 0 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 0 | 0 | 58 | 0 | 55 | 0 | 54 | 6 0 |
| 6 12 | 0 | 56 | 0 | 56 | 0 | 58 | 1 | 0 | 1 | 2 | 1 | 4 | 1 | 4 | 1 | 4 | 1 | 2 | 1 | 0 | 0 | 57 | 0 | 56 | 6 12 |
| 6 24 | 0 | 58 | 0 | 58 | 1 | 0 | 1 | 2 | 1 | 4 | 1 | 6 | 1 | 6 | 1 | 6 | 1 | 4 | 1 | 2 | 0 | 59 | 0 | 58 | 6 24 |
| 6 36 | 1 | 0 | 1 | 0 | 1 | 2 | 1 | 4 | 1 | 6 | 1 | 8 | 1 | 9 | 1 | 8 | 1 | 6 | 1 | 3 | 1 | 1 | 0 | 59 | 6 36 |
| 6 48 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 6 | 1 | 8 | 1 | 10 | 1 | 11 | 1 | 10 | 1 | 8 | 1 | 5 | 1 | 3 | 1 | 1 | 6 48 |
| 7 0 | 1 | 4 | 1 | 4 | 1 | 5 | 1 | 8 | 1 | 10 | 1 | 12 | 1 | 13 | 1 | 12 | 1 | 10 | 1 | 7 | 1 | 5 | 1 | 3 | 7 0 |
| 7 12 | 1 | 5 | 1 | 6 | 1 | 7 | 1 | 10 | 1 | 12 | 1 | 14 | 1 | 15 | 1 | 14 | 1 | 12 | 1 | 9 | 1 | 7 | 1 | 5 | 7 12 |
| 7 24 | 1 | 7 | 1 | 7 | 1 | 9 | 1 | 12 | 1 | 14 | 1 | 16 | 1 | 17 | 1 | 16 | 1 | 14 | 1 | 11 | 1 | 8 | 1 | 7 | 7 24 |
| 7 36 | 1 | 9 | 1 | 9 | 1 | 11 | 1 | 14 | 1 | 16 | 1 | 18 | 1 | 19 | 1 | 18 | 1 | 16 | 1 | 13 | 1 | 10 | 1 | 9 | 7 36 |
| 7 48 | 1 | 11 | 1 | 11 | 1 | 13 | 1 | 16 | 1 | 18 | 1 | 20 | 1 | 21 | 1 | 20 | 1 | 18 | 1 | 15 | 1 | 12 | 1 | 10 | 7 48 |
| 8 0 | 1 | 13 | 1 | 13 | 1 | 15 | 1 | 17 | 1 | 20 | 1 | 22 | 1 | 23 | 1 | 22 | 1 | 20 | 1 | 17 | 1 | 14 | 1 | 12 | 8 0 |
| 8 12 | 1 | 14 | 1 | 15 | 1 | 17 | 1 | 19 | 1 | 22 | 1 | 25 | 1 | 25 | 1 | 24 | 1 | 22 | 1 | 19 | 1 | 16 | 1 | 14 | 8 12 |
| 8 24 | 1 | 16 | 1 | 16 | 1 | 18 | 1 | 21 | 1 | 24 | 1 | 27 | 1 | 27 | 1 | 26 | 1 | 24 | 1 | 21 | 1 | 18 | 1 | 16 | 8 24 |
| 8 36 | 1 | 18 | 1 | 18 | 1 | 20 | 1 | 23 | 1 | 26 | 1 | 29 | 1 | 29 | 1 | 28 | 1 | 26 | 1 | 23 | 1 | 19 | 1 | 18 | 8 36 |
| 8 48 | 1 | 20 | 1 | 20 | 1 | 22 | 1 | 25 | 1 | 28 | 1 | 31 | 1 | 31 | 1 | 30 | 1 | 28 | 1 | 25 | 1 | 21 | 1 | 19 | 8 48 |
| 9 0 | 1 | 22 | 1 | 22 | 1 | 24 | 1 | 27 | 1 | 30 | 1 | 33 | 1 | 34 | 1 | 32 | 1 | 30 | 1 | 26 | 1 | 23 | 1 | 21 | 9 0 |
| 9 12 | 1 | 24 | 1 | 24 | 1 | 26 | 1 | 29 | 1 | 32 | 1 | 35 | 1 | 36 | 1 | 35 | 1 | 32 | 1 | 28 | 1 | 25 | 1 | 23 | 9 12 |
| 9 24 | 1 | 26 | 1 | 26 | 1 | 28 | 1 | 31 | 1 | 34 | 1 | 37 | 1 | 38 | 1 | 37 | 1 | 34 | 1 | 30 | 1 | 27 | 1 | 25 | 9 24 |
| 9 36 | 1 | 27 | 1 | 27 | 1 | 30 | 1 | 33 | 1 | 36 | 1 | 39 | 1 | 40 | 1 | 39 | 1 | 36 | 1 | 32 | 1 | 29 | 1 | 27 | 9 36 |
| 9 48 | 1 | 29 | 1 | 29 | 1 | 32 | 1 | 35 | 1 | 38 | 1 | 41 | 1 | 42 | 1 | 41 | 1 | 38 | 1 | 34 | 1 | 31 | 1 | 28 | 9 48 |
| 10 0 | 1 | 31 | 1 | 31 | 1 | 33 | 1 | 37 | 1 | 40 | 1 | 43 | 1 | 44 | 1 | 43 | 1 | 40 | 1 | 36 | 1 | 32 | 1 | 30 | 10 0 |
| 10 12 | 1 | 33 | 1 | 33 | 1 | 35 | 1 | 39 | 1 | 42 | 1 | 45 | 1 | 46 | 1 | 45 | 1 | 42 | 1 | 38 | 1 | 34 | 1 | 32 | 10 12 |
| 10 24 | 1 | 34 | 1 | 35 | 1 | 37 | 1 | 41 | 1 | 44 | 1 | 47 | 1 | 48 | 1 | 47 | 1 | 44 | 1 | 40 | 1 | 36 | 1 | 34 | 10 24 |
| 10 36 | 1 | 36 | 1 | 37 | 1 | 39 | 1 | 43 | 1 | 46 | 1 | 49 | 1 | 50 | 1 | 49 | 1 | 46 | 1 | 42 | 1 | 38 | 1 | 36 | 10 36 |
| 10 48 | 1 | 38 | 1 | 38 | 1 | 41 | 1 | 45 | 1 | 48 | 1 | 51 | 1 | 52 | 1 | 51 | 1 | 48 | 1 | 44 | 1 | 40 | 1 | 37 | 10 48 |
| 11 0 | 1 | 40 | 1 | 40 | 1 | 43 | 1 | 46 | 1 | 50 | 1 | 53 | 1 | 54 | 1 | 53 | 1 | 50 | 1 | 46 | 1 | 42 | 1 | 39 | 11 0 |
| 11 12 | 1 | 42 | 1 | 42 | 1 | 45 | 1 | 48 | 1 | 52 | 1 | 55 | 1 | 56 | 1 | 55 | 1 | 52 | 1 | 48 | 1 | 44 | 1 | 41 | 11 12 |
| 11 24 | 1 | 44 | 1 | 44 | 1 | 46 | 1 | 50 | 1 | 54 | 1 | 57 | 1 | 59 | 1 | 57 | 1 | 54 | 1 | 49 | 1 | 45 | 1 | 43 | 11 24 |
| 11 36 | 1 | 45 | 1 | 46 | 1 | 48 | 1 | 52 | 1 | 57 | 2 | 0 | 2 | 1 | 1 | 59 | 1 | 56 | 1 | 51 | 1 | 47 | 1 | 45 | 11 36 |
| 11 48 | 1 | 47 | 1 | 48 | 1 | 50 | 1 | 54 | 1 | 59 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 58 | 1 | 53 | 1 | 49 | 1 | 46 | 11 48 |
| 12 0 | 1 | 49 | 1 | 49 | 1 | 52 | 1 | 56 | 2 | 1 | 2 | 4 | 2 | 5 | 2 | 3 | 2 | 0 | 1 | 55 | 1 | 51 | 1 | 48 | 12 0 |

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# TABLE XXII.

## For reducing the SUN'S RIGHT ASCENSION to any Time at the Meridian of Greenwich.

| Time fr. Noon. | SUN'S RIGHT ASCENSION. | | | | | | | | | | | | Time fr. Noon. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12h. | 13h. | 14h. | 15h. | 16h. | 17h. | 18h. | 19h. | 20h. | 21h. | 22h. | 23h. | |
| h. m. | m. s. | m. s. | m. s. | m. s. | m. s. | m. s. | m. s. | m. s. | m. s. | m. s. | m. s. | m. s. | h. m. |
| 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 0 12 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 2 | 0 12 |
| 0 24 | 0 4 | 0 4 | 0 4 | 0 4 | 0 4 | 0 4 | 0 5 | 0 4 | 0 4 | 0 4 | 0 4 | 0 4 | 0 24 |
| 0 36 | 0 5 | 0 5 | 0 6 | 0 6 | 0 6 | 0 7 | 0 7 | 0 7 | 0 6 | 0 6 | 0 6 | 0 6 | 0 36 |
| 0 48 | 0 7 | 0 7 | 0 8 | 0 8 | 0 8 | 0 9 | 0 9 | 0 9 | 0 8 | 0 8 | 0 8 | 0 7 | 0 48 |
| 1 0 | 0 9 | 0 9 | 0 10 | 0 10 | 0 11 | 0 11 | 0 11 | 0 11 | 0 11 | 0 10 | 0 10 | 0 9 | 1 0 |
| 1 12 | 0 11 | 0 11 | 0 11 | 0 12 | 0 13 | 0 13 | 0 13 | 0 13 | 0 13 | 0 12 | 0 12 | 0 11 | 1 12 |
| 1 24 | 0 13 | 0 13 | 0 13 | 0 14 | 0 15 | 0 15 | 0 16 | 0 15 | 0 15 | 0 14 | 0 14 | 0 13 | 1 24 |
| 1 36 | 0 14 | 0 15 | 0 15 | 0 16 | 0 17 | 0 17 | 0 18 | 0 18 | 0 17 | 0 16 | 0 15 | 0 15 | 1 36 |
| 1 48 | 0 16 | 0 17 | 0 17 | 0 18 | 0 19 | 0 20 | 0 20 | 0 20 | 0 19 | 0 18 | 0 17 | 0 17 | 1 48 |
| 2 0 | 0 18 | 0 18 | 0 19 | 0 20 | 0 21 | 0 22 | 0 22 | 0 22 | 0 21 | 0 20 | 0 19 | 0 19 | 2 0 |
| 2 12 | 0 20 | 0 20 | 0 21 | 0 22 | 0 23 | 0 24 | 0 24 | 0 24 | 0 23 | 0 22 | 0 21 | 0 21 | 2 12 |
| 2 24 | 0 22 | 0 22 | 0 23 | 0 24 | 0 25 | 0 26 | 0 27 | 0 26 | 0 25 | 0 24 | 0 23 | 0 23 | 2 24 |
| 2 36 | 0 23 | 0 24 | 0 25 | 0 26 | 0 27 | 0 28 | 0 29 | 0 29 | 0 28 | 0 26 | 0 25 | 0 24 | 2 36 |
| 2 48 | 0 25 | 0 26 | 0 27 | 0 28 | 0 30 | 0 31 | 0 31 | 0 31 | 0 30 | 0 28 | 0 27 | 0 26 | 2 48 |
| 3 0 | 0 27 | 0 28 | 0 29 | 0 30 | 0 32 | 0 33 | 0 33 | 0 33 | 0 32 | 0 30 | 0 29 | 0 28 | 3 0 |
| 3 12 | 0 29 | 0 29 | 0 31 | 0 32 | 0 34 | 0 35 | 0 35 | 0 35 | 0 34 | 0 32 | 0 31 | 0 30 | 3 12 |
| 3 24 | 0 31 | 0 31 | 0 33 | 0 34 | 0 36 | 0 37 | 0 38 | 0 37 | 0 36 | 0 35 | 0 33 | 0 32 | 3 24 |
| 3 36 | 0 32 | 0 33 | 0 34 | 0 36 | 0 38 | 0 39 | 0 40 | 0 40 | 0 38 | 0 37 | 0 35 | 0 34 | 3 36 |
| 3 48 | 0 34 | 0 35 | 0 36 | 0 38 | 0 40 | 0 42 | 0 42 | 0 42 | 0 40 | 0 39 | 0 37 | 0 36 | 3 48 |
| 4 0 | 0 36 | 0 37 | 0 38 | 0 40 | 0 42 | 0 44 | 0 44 | 0 44 | 0 43 | 0 41 | 0 39 | 0 37 | 4 0 |
| 4 12 | 0 38 | 0 39 | 0 40 | 0 42 | 0 44 | 0 46 | 0 47 | 0 46 | 0 45 | 0 43 | 0 41 | 0 39 | 4 12 |
| 4 24 | 0 40 | 0 40 | 0 42 | 0 44 | 0 47 | 0 48 | 0 49 | 0 48 | 0 47 | 0 45 | 0 43 | 0 41 | 4 24 |
| 4 36 | 0 41 | 0 42 | 0 44 | 0 46 | 0 49 | 0 50 | 0 51 | 0 51 | 0 49 | 0 47 | 0 44 | 0 43 | 4 36 |
| 4 48 | 0 43 | 0 44 | 0 46 | 0 48 | 0 51 | 0 53 | 0 53 | 0 53 | 0 51 | 0 49 | 0 46 | 0 45 | 4 48 |
| 5 0 | 0 45 | 0 46 | 0 48 | 0 50 | 0 53 | 0 55 | 0 56 | 0 55 | 0 53 | 0 51 | 0 48 | 0 47 | 5 0 |
| 5 12 | 0 47 | 0 48 | 0 50 | 0 52 | 0 55 | 0 57 | 0 58 | 0 57 | 0 55 | 0 53 | 0 50 | 0 49 | 5 12 |
| 5 24 | 0 49 | 0 50 | 0 52 | 0 54 | 0 57 | 0 59 | 1 0 | 0 59 | 0 58 | 0 55 | 0 52 | 0 51 | 5 24 |
| 5 36 | 0 50 | 0 51 | 0 54 | 0 56 | 0 59 | 1 1 | 1 2 | 1 2 | 1 0 | 0 57 | 0 54 | 0 52 | 5 36 |
| 5 48 | 0 52 | 0 53 | 0 56 | 0 59 | 1 1 | 1 4 | 1 4 | 1 4 | 1 2 | 0 59 | 0 56 | 0 54 | 5 48 |
| 6 0 | 0 54 | 0 55 | 0 58 | 1 1 | 1 4 | 1 6 | 1 7 | 1. 6 | 1 4 | 1 1 | 0 58 | 0 56 | 6 0 |
| 6 12 | 0 56 | 0 57 | 0 59 | 1 3 | 1 6 | 1 8 | 1 9 | 1 8 | 1 6 | 1 3 | 1 0 | 0 58 | 6 12 |
| 6 24 | 0 58 | 0 59 | 1 1 | 1 5 | 1 8 | 1 10 | 1 11 | 1 10 | 1 8 | 1 5 | 1 2 | 1 0 | 6 24 |
| 6 36 | 0 59 | 1 1 | 1 3 | 1 7 | 1 10 | 1 12 | 1 13 | 1 13 | 1 10 | 1 7 | 1 4 | 1 2 | 6 36 |
| 6 48 | 1 1 | 1 2 | 1 5 | 1 9 | 1 12 | 1 15 | 1 16 | 1 15 | 1 12 | 1 9 | 1 6 | 1 4 | 6 48 |
| 7 0 | 1 3 | 1 4 | 1 7 | 1 11 | 1 14 | 1 17 | 1 18 | 1 17 | 1 14 | 1 11 | 1 8 | 1 6 | 7 0 |
| 7 12 | 1 5 | 1 6 | 1 9 | 1 13 | 1 16 | 1 19 | 1 20 | 1 19 | 1 17 | 1 13 | 1 10 | 1 7 | 7 12 |
| 7 24 | 1 7 | 1 8 | 1 11 | 1 15 | 1 18 | 1 21 | 1 22 | 1 21 | 1 19 | 1 15 | 1 12 | 1 9 | 7 24 |
| 7 36 | 1 8 | 1 10 | 1 13 | 1 17 | 1 20 | 1 23 | 1 24 | 1 24 | 1 21 | 1 17 | 1 14 | 1 11 | 7 36 |
| 7 48 | 1 10 | 1 12 | 1 15 | 1 19 | 1 23 | 1 25 | 1 27 | 1 26 | 1 23 | 1 19 | 1 16 | 1 13 | 7 48 |
| 8 0 | 1 12 | 1 13 | 1 17 | 1 21 | 1 25 | 1 28 | 1 29 | 1 28 | 1 25 | 1 21 | 1 17 | 1 15 | 8 0 |
| 8 12 | 1 14 | 1 15 | 1 19 | 1 23 | 1 27 | 1 30 | 1 31 | 1 30 | 1 27 | 1 23 | 1 19 | 1 17 | 8 12 |
| 8 24 | 1 16 | 1 17 | 1 21 | 1 25 | 1 29 | 1 32 | 1 33 | 1 32 | 1 29 | 1 25 | 1 21 | 1 19 | 8 24 |
| 8 36 | 1 17 | 1 19 | 1 22 | 1 27 | 1 31 | 1 34 | 1 36 | 1 35 | 1 32 | 1 27 | 1 23 | 1 21 | 8 36 |
| 8 48 | 1 19 | 1 21 | 1 24 | 1 29 | 1 33 | 1 36 | 1 38 | 1 37 | 1 34 | 1 29 | 1 25 | 1 22 | 8 48 |
| 9 0 | 1 21 | 1 23 | 1 26 | 1 31 | 1 35 | 1 39 | 1 40 | 1 39 | 1 36 | 1 31 | 1 27 | 1 24 | 9 0 |
| 9 12 | 1 23 | 1 25 | 1 28 | 1 33 | 1 37 | 1 41 | 1 42 | 1 41 | 1 38 | 1 33 | 1 29 | 1 26 | 9 12 |
| 9 24 | 1 25 | 1 26 | 1 30 | 1 35 | 1 40 | 1 43 | 1 44 | 1 43 | 1 40 | 1 36 | 1 31 | 1 28 | 9 24 |
| 9 36 | 1 26 | 1 28 | 1 32 | 1 37 | 1 42 | 1 45 | 1 47 | 1 46 | 1 42 | 1 38 | 1 33 | 1 30 | 9 36 |
| 9 48 | 1 28 | 1 30 | 1 34 | 1 39 | 1 44 | 1 47 | 1 49 | 1 48 | 1 44 | 1 40 | 1 35 | 1 32 | 9 48 |
| 10 0 | 1 30 | 1 32 | 1 36 | 1 41 | 1 46 | 1 50 | 1 51 | 1 50 | 1 46 | 1 42 | 1 37 | 1 34 | 10 0 |
| 10 12 | 1 32 | 1 34 | 1 38 | 1 43 | 1 48 | 1 52 | 1 53 | 1 52 | 1 49 | 1 44 | 1 39 | 1 36 | 10 12 |
| 10 24 | 1 34 | 1 36 | 1 40 | 1 45 | 1 50 | 1 54 | 1 56 | 1 54 | 1 51 | 1 46 | 1 41 | 1 38 | 10 24 |
| 10 36 | 1 35 | 1 37 | 1 42 | 1 47 | 1 52 | 1 56 | 1 58 | 1 57 | 1 53 | 1 48 | 1 43 | 1 39 | 10 36 |
| 10 48 | 1 37 | 1 39 | 1 44 | 1 49 | 1 54 | 1 58 | 2 0 | 1 59 | 1 55 | 1 50 | 1 45 | 1 41 | 10 48 |
| 11 0 | 1 39 | 1 41 | 1 46 | 1 51 | 1 57 | 2 1 | 2 2 | 2 1 | 1 57 | 1 52 | 1 46 | 1 43 | 11 0 |
| 11 12 | 1 41 | 1 43 | 1 47 | 1 53 | 1 59 | 2 3 | 2 4 | 2 3 | 1 59 | 1 54 | 1 48 | 1 45 | 11 12 |
| 11 24 | 1 43 | 1 45 | 1 49 | 1 55 | 2 1 | 2 5 | 2 7 | 2 5 | 2 1 | 1 56 | 1 50 | 1 47 | 11 24 |
| 11 36 | 1 44 | 1 47 | 1 51 | 1 57 | 2 3 | 2 7 | 2 9 | 2 8 | 2 4 | 1 58 | 1 52 | 1 49 | 11 36 |
| 11 48 | 1 46 | 1 48 | 1 53 | 1 59 | 2 5 | 2 9 | 2 11 | 2 10 | 2 6 | 2 0 | 1 54 | 1 51 | 11 48 |
| 12 0 | 1 48 | 1 50 | 1 55 | 2 1 | 2 7 | 2 12 | 2 13 | 2 12 | 2 8 | 2 2 | 1 56 | 1 52 | 12 0 |

## TABLE XXIII.

LOGARITHMIC SINES, TANGENTS, and SECANTS, to every Point and Quarter Point of the Compass.

| Points. | Sine. | Co-sine. | Tangent. | Co-tang. | Secant. | Co-sec. | Points. |
|---|---|---|---|---|---|---|---|
| 0 | 0.000000 | 10.000000 | 0.000000 | Infinite. | 10.000000 | Infinite. | 8 |
| 0 ¼ | 8.690796 | 9.999477 | 8.691319 | 11.308681 | 10.000523 | 11.309204 | 7 ¾ |
| 0 ½ | 8.991302 | 9.997904 | 8.993398 | 11.006602 | 10.002096 | 11.008698 | 7 ½ |
| 0 ¾ | 9.166520 | 9.995274 | 9.171247 | 10.828753 | 10.004726 | 10.833480 | 7 ¼ |
| 1 | 9.290236 | 9.991574 | 9.298662 | 10.701338 | 10.008426 | 10.709764 | 7 |
| 1 ¼ | 9.385571 | 9.986786 | 9.398785 | 10.601215 | 10.013214 | 10.614429 | 6 ¾ |
| 1 ½ | 9.462824 | 9.980885 | 9.481939 | 10.518061 | 10.019115 | 10.537176 | 6 ½ |
| 1 ¾ | 9.527488 | 9.973841 | 9.553647 | 10.446353 | 10.026159 | 10.472512 | 6 ¼ |
| 2 | 9.582840 | 9.965615 | 9.617224 | 10.382776 | 10.034385 | 10.417160 | 6 |
| 2 ¼ | 9.630992 | 9.956163 | 9.674829 | 10.325171 | 10.043837 | 10.369008 | 5 ¾ |
| 2 ½ | 9.673387 | 9.945430 | 9.727957 | 10.272043 | 10.054570 | 10.326613 | 5 ½ |
| 2 ¾ | 9.711050 | 9.933350 | 9.777700 | 10.222300 | 10.066650 | 10.288950 | 5 ¼ |
| 3 | 9.744739 | 9.919846 | 9.824893 | 10.175107 | 10.080154 | 10.255261 | 5 |
| 3 ¼ | 9.775027 | 9.904828 | 9.870199 | 10.129801 | 10.095172 | 10.224973 | 4 ¾ |
| 3 ½ | 9.802359 | 9.888185 | 9.914173 | 10.085827 | 10.111815 | 10.197641 | 4 ½ |
| 3 ¾ | 9.827084 | 9.869790 | 9.957295 | 10.042705 | 10.130210 | 10.172916 | 4 ¼ |
| 4 | 9.849485 | 9.849485 | 10.000000 | 10.000000 | 10.150515 | 10.150515 | 4 |
| | Co-sine. | Sine. | Co-tang. | Tangent. | Co-sec. | Secant. | |

## TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 1——100 Log. 0.000000——2.000000

| No. | Log. | No. | Log. | No. | Log. | No. | Log. | No. | Log. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.000000 | 21 | 1.322219 | 41 | 1.612784 | 61 | 1.785330 | 81 | 1.908485 |
| 2 | 0.301030 | 22 | 1.342423 | 42 | 1.623249 | 62 | 1.792392 | 82 | 1.913814 |
| 3 | 0.477121 | 23 | 1.361728 | 43 | 1.633468 | 63 | 1.799341 | 83 | 1.919078 |
| 4 | 0.602060 | 24 | 1.380211 | 44 | 1.643453 | 64 | 1.806180 | 84 | 1.924279 |
| 5 | 0.698970 | 25 | 1.397940 | 45 | 1.653213 | 65 | 1.812913 | 85 | 1.929419 |
| 6 | 0.778151 | 26 | 1.414973 | 46 | 1.662758 | 66 | 1.819544 | 86 | 1.934498 |
| 7 | 0.845098 | 27 | 1.431364 | 47 | 1.672098 | 67 | 1.826075 | 87 | 1.939519 |
| 8 | 0.903090 | 28 | 1.447158 | 48 | 1.681241 | 68 | 1.832509 | 88 | 1.944483 |
| 9 | 0.954243 | 29 | 1.462398 | 49 | 1.690196 | 69 | 1.838849 | 89 | 1.949390 |
| 10 | 1.000000 | 30 | 1.477121 | 50 | 1.698970 | 70 | 1.845098 | 90 | 1.954243 |
| 11 | 1.041393 | 31 | 1.491362 | 51 | 1.707570 | 71 | 1.851258 | 91 | 1.959041 |
| 12 | 1.079181 | 32 | 1.505150 | 52 | 1.716003 | 72 | 1.857332 | 92 | 1.963788 |
| 13 | 1.113943 | 33 | 1.518514 | 53 | 1.724276 | 73 | 1.863323 | 93 | 1.968483 |
| 14 | 1.146128 | 34 | 1.531479 | 54 | 1.732394 | 74 | 1.869232 | 94 | 1.973128 |
| 15 | 1.176091 | 35 | 1.544068 | 55 | 1.740363 | 75 | 1.875061 | 95 | 1.977724 |
| 16 | 1.204120 | 36 | 1.556302 | 56 | 1.748188 | 76 | 1.880814 | 96 | 1.982271 |
| 17 | 1.230449 | 37 | 1.568202 | 57 | 1.755875 | 77 | 1.886491 | 97 | 1.986772 |
| 18 | 1.255273 | 38 | 1.579784 | 58 | 1.763428 | 78 | 1.892095 | 98 | 1.991226 |
| 19 | 1.278754 | 39 | 1.591065 | 59 | 1.770852 | 79 | 1.897627 | 99 | 1.995635 |
| 20 | 1.301030 | 40 | 1.602060 | 60 | 1.778151 | 80 | 1.903090 | 100 | 2.000000 |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 1000———1600 Log. 000000———204120

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 000000 | 000434 | 000868 | 001301 | 001734 | 002166 | 002598 | 003029 | 003460 | 003891 | 432 |
| 101 | 004321 | 004751 | 005180 | 005609 | 006038 | 006466 | 006894 | 007321 | 007748 | 008174 | 428 |
| 102 | 008600 | 009026 | 009451 | 009876 | 010300 | 010724 | 011147 | 011570 | 011993 | 012415 | 424 |
| 103 | 012837 | 013259 | 013680 | 014100 | 014520 | 014940 | 015360 | 015779 | 016197 | 016615 | 420 |
| 104 | 017033 | 017451 | 017868 | 018284 | 018700 | 019116 | 019532 | 019947 | 020361 | 020775 | 416 |
| 105 | 021189 | 021603 | 022016 | 022428 | 022841 | 023252 | 023664 | 024075 | 024486 | 024896 | 412 |
| 106 | 025306 | 025715 | 026124 | 026533 | 026942 | 027350 | 027757 | 028164 | 028571 | 028978 | 408 |
| 107 | 029384 | 029789 | 030195 | 030600 | 031004 | 031408 | 031812 | 032216 | 032619 | 033021 | 404 |
| 108 | 033424 | 033826 | 034227 | 034628 | 035029 | 035430 | 035830 | 036229 | 036629 | 037028 | 400 |
| 109 | 037426 | 037825 | 038223 | 038620 | 039017 | 039414 | 039811 | 040207 | 040602 | 040998 | 397 |
| 110 | 041393 | 041787 | 042182 | 042575 | 042969 | 043362 | 043755 | 044148 | 044540 | 044931 | 393 |
| 111 | 045323 | 045714 | 046105 | 046495 | 046885 | 047275 | 047664 | 048053 | 048442 | 048830 | 390 |
| 112 | 049218 | 049606 | 049993 | 050380 | 050766 | 051152 | 051538 | 051924 | 052309 | 052694 | 386 |
| 113 | 053078 | 053463 | 053846 | 054230 | 054613 | 054996 | 055378 | 055760 | 056142 | 056524 | 383 |
| 114 | 056905 | 057286 | 057666 | 058046 | 058426 | 058805 | 059185 | 059563 | 059942 | 060320 | 379 |
| 115 | 060698 | 061075 | 061452 | 061829 | 062206 | 062582 | 062958 | 063333 | 063709 | 064083 | 376 |
| 116 | 064458 | 064832 | 065206 | 065580 | 065953 | 066326 | 066699 | 067071 | 067443 | 067814 | 373 |
| 117 | 068186 | 068557 | 068928 | 069298 | 069668 | 070038 | 070407 | 070776 | 071145 | 071514 | 370 |
| 118 | 071882 | 072250 | 072617 | 072985 | 073352 | 073718 | 074085 | 074451 | 074816 | 075182 | 366 |
| 119 | 075547 | 075912 | 076276 | 076640 | 077004 | 077368 | 077731 | 078094 | 078457 | 078819 | 363 |
| 120 | 079181 | 079543 | 079904 | 080266 | 080626 | 080987 | 081347 | 081707 | 082067 | 082426 | 360 |
| 121 | 082785 | 083144 | 083503 | 083861 | 084219 | 084576 | 084934 | 085291 | 085647 | 086004 | 357 |
| 122 | 086360 | 086716 | 087071 | 087426 | 087781 | 088136 | 088490 | 088845 | 089198 | 089552 | 355 |
| 123 | 089905 | 090258 | 090611 | 090963 | 091315 | 091667 | 092018 | 092370 | 092721 | 093071 | 352 |
| 124 | 093422 | 093772 | 094122 | 094471 | 094820 | 095169 | 095518 | 095866 | 096215 | 096562 | 349 |
| 125 | 096910 | 097257 | 097604 | 097951 | 098297 | 098644 | 098990 | 099335 | 099681 | 100026 | 346 |
| 126 | 100370 | 100715 | 101059 | 101403 | 101747 | 102090 | 102434 | 102777 | 103119 | 103462 | 343 |
| 127 | 103804 | 104146 | 104487 | 104828 | 105169 | 105510 | 105851 | 106191 | 106531 | 106870 | 341 |
| 128 | 107210 | 107549 | 107888 | 108227 | 108565 | 108903 | 109241 | 109578 | 109916 | 110253 | 338 |
| 129 | 110590 | 110926 | 111262 | 111598 | 111934 | 112270 | 112605 | 112940 | 113275 | 113609 | 335 |
| 130 | 113943 | 114277 | 114611 | 114944 | 115278 | 115610 | 115943 | 116276 | 116608 | 116940 | 332 |
| 131 | 117271 | 117603 | 117934 | 118265 | 118595 | 118926 | 119256 | 119586 | 119915 | 120245 | 330 |
| 132 | 120574 | 120903 | 121231 | 121560 | 121888 | 122216 | 122543 | 122871 | 123198 | 123525 | 328 |
| 133 | 123852 | 124178 | 124504 | 124830 | 125156 | 125481 | 125806 | 126131 | 126456 | 126781 | 325 |
| 134 | 127105 | 127429 | 127752 | 128076 | 128399 | 128722 | 129045 | 129368 | 129690 | 130012 | 323 |
| 135 | 130334 | 130655 | 130977 | 131298 | 131619 | 131939 | 132260 | 132580 | 132900 | 133219 | 321 |
| 136 | 133539 | 133858 | 134177 | 134496 | 134814 | 135133 | 135451 | 135768 | 136086 | 136403 | 318 |
| 137 | 136721 | 137037 | 137354 | 137670 | 137987 | 138303 | 138618 | 138934 | 139249 | 139564 | 316 |
| 138 | 139879 | 140194 | 140508 | 140822 | 141136 | 141450 | 141763 | 142076 | 142389 | 142702 | 314 |
| 139 | 143015 | 143327 | 143639 | 143951 | 144263 | 144574 | 144885 | 145196 | 145507 | 145818 | 311 |
| 140 | 146128 | 146438 | 146748 | 147058 | 147367 | 147676 | 147985 | 148294 | 148603 | 148911 | 309 |
| 141 | 149219 | 149527 | 149835 | 150142 | 150449 | 150756 | 151063 | 151370 | 151676 | 151982 | 307 |
| 142 | 152286 | 152594 | 152900 | 153205 | 153510 | 153815 | 154119 | 154424 | 154728 | 155032 | 305 |
| 143 | 155336 | 155640 | 155943 | 156246 | 156549 | 156852 | 157154 | 157457 | 157759 | 158061 | 303 |
| 144 | 158362 | 158664 | 158965 | 159266 | 159567 | 159868 | 160168 | 160468 | 160769 | 161068 | 300 |
| 145 | 161368 | 161667 | 161967 | 162266 | 162564 | 162863 | 163161 | 163460 | 163757 | 164055 | 298 |
| 146 | 164353 | 164650 | 164947 | 165244 | 165541 | 165838 | 166134 | 166430 | 166726 | 167022 | 296 |
| 147 | 167317 | 167613 | 167908 | 168203 | 168497 | 168792 | 169086 | 169380 | 169674 | 169968 | 294 |
| 148 | 170262 | 170555 | 170848 | 171141 | 171434 | 171726 | 172019 | 172311 | 172603 | 172895 | 292 |
| 149 | 173186 | 173478 | 173769 | 174060 | 174351 | 174641 | 174932 | 175222 | 175512 | 175802 | 290 |
| 150 | 176091 | 176381 | 176670 | 176959 | 177248 | 177536 | 177825 | 178113 | 178401 | 178689 | 288 |
| 151 | 178977 | 179264 | 179552 | 179839 | 180126 | 180413 | 180699 | 180986 | 181272 | 181558 | 287 |
| 152 | 181844 | 182129 | 182415 | 182700 | 182985 | 183270 | 183554 | 183839 | 184123 | 184407 | 285 |
| 153 | 184691 | 184975 | 185259 | 185542 | 185825 | 186108 | 186391 | 186674 | 186956 | 187239 | 283 |
| 154 | 187521 | 187803 | 188084 | 188366 | 188647 | 188928 | 189209 | 189490 | 189771 | 190051 | 281 |
| 155 | 190332 | 190612 | 190892 | 191171 | 191451 | 191730 | 192010 | 192289 | 192567 | 192846 | 279 |
| 156 | 193125 | 193403 | 193681 | 193959 | 194237 | 194514 | 194792 | 195069 | 195346 | 195623 | 278 |
| 157 | 195900 | 196176 | 196452 | 196729 | 197005 | 197281 | 197556 | 197832 | 198107 | 198382 | 276 |
| 158 | 198657 | 198932 | 199206 | 199481 | 199755 | 200029 | 200303 | 200577 | 200850 | 201124 | 274 |
| 159 | 201397 | 201670 | 201943 | 202216 | 202488 | 202761 | 203033 | 203305 | 203577 | 203848 | 272 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 1600——2200 Log. 204120——342423

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 160 | 204120 | 204391 | 204662 | 204933 | 205204 | 205475 | 205745 | 206016 | 206286 | 206556 | 271 |
| 161 | 206826 | 207095 | 207365 | 207634 | 207903 | 208172 | 208441 | 208710 | 208978 | 209247 | 269 |
| 162 | 209515 | 209783 | 210051 | 210318 | 210586 | 210853 | 211120 | 211388 | 211654 | 211921 | 267 |
| 163 | 212188 | 212454 | 212720 | 212986 | 213252 | 213518 | 213783 | 214049 | 214314 | 214579 | 266 |
| 164 | 214844 | 215109 | 215373 | 215638 | 215902 | 216166 | 216430 | 216694 | 216957 | 217221 | 264 |
| 165 | 217484 | 217747 | 218010 | 218273 | 218535 | 218798 | 219060 | 219322 | 219584 | 219846 | 262 |
| 166 | 220108 | 220370 | 220631 | 220892 | 221153 | 221414 | 221675 | 221936 | 222196 | 222456 | 261 |
| 167 | 222716 | 222976 | 223236 | 223496 | 223755 | 224015 | 224274 | 224533 | 224792 | 225051 | 259 |
| 168 | 225309 | 225568 | 225826 | 226084 | 226342 | 226600 | 226858 | 227115 | 227372 | 227630 | 258 |
| 169 | 227887 | 228144 | 228400 | 228657 | 228913 | 229170 | 229426 | 229682 | 229938 | 230193 | 256 |
| 170 | 230449 | 230704 | 230960 | 231215 | 231470 | 231724 | 231979 | 232233 | 232488 | 232742 | 255 |
| 171 | 232996 | 233250 | 233504 | 233757 | 234011 | 234264 | 234517 | 234770 | 235023 | 235276 | 253 |
| 172 | 235528 | 235781 | 236033 | 236285 | 236537 | 236789 | 237041 | 237292 | 237544 | 237795 | 252 |
| 173 | 238046 | 238297 | 238548 | 238799 | 239049 | 239299 | 239550 | 239800 | 240050 | 240300 | 250 |
| 174 | 240549 | 240799 | 241048 | 241297 | 241546 | 241795 | 242044 | 242293 | 242541 | 242790 | 249 |
| 175 | 243038 | 243286 | 243534 | 243782 | 244030 | 244277 | 244524 | 244772 | 245019 | 245266 | 247 |
| 176 | 245513 | 245759 | 246006 | 246252 | 246499 | 246745 | 246991 | 247236 | 247482 | 247728 | 246 |
| 177 | 247973 | 248219 | 248464 | 248709 | 248954 | 249198 | 249443 | 249687 | 249932 | 250176 | 245 |
| 178 | 250420 | 250664 | 250908 | 251151 | 251395 | 251638 | 251881 | 252125 | 252367 | 252610 | 243 |
| 179 | 252853 | 253096 | 253338 | 253580 | 253822 | 254064 | 254306 | 254548 | 254790 | 255031 | 242 |
| 180 | 255273 | 255514 | 255755 | 255996 | 256236 | 256477 | 256718 | 256958 | 257198 | 257439 | 241 |
| 181 | 257679 | 257918 | 258158 | 258398 | 258637 | 258877 | 259116 | 259355 | 259594 | 259833 | 239 |
| 182 | 260071 | 260310 | 260548 | 260787 | 261025 | 261263 | 261501 | 261738 | 261976 | 262214 | 238 |
| 183 | 262451 | 262688 | 262925 | 263162 | 263399 | 263636 | 263873 | 264109 | 264345 | 264582 | 237 |
| 184 | 264818 | 265054 | 265290 | 265525 | 265761 | 265996 | 266232 | 266467 | 266702 | 266937 | 235 |
| 185 | 267172 | 267406 | 267641 | 267875 | 268110 | 268344 | 268578 | 268812 | 269046 | 269279 | 234 |
| 186 | 269513 | 269746 | 269980 | 270213 | 270446 | 270679 | 270912 | 271144 | 271377 | 271609 | 233 |
| 187 | 271842 | 272074 | 272306 | 272538 | 272770 | 273001 | 273233 | 273464 | 273696 | 273927 | 232 |
| 188 | 274158 | 274389 | 274620 | 274850 | 275081 | 275311 | 275542 | 275772 | 276002 | 276232 | 230 |
| 189 | 276462 | 276691 | 276921 | 277151 | 277380 | 277609 | 277838 | 278067 | 278296 | 278525 | 229 |
| 190 | 278754 | 278982 | 279210 | 279439 | 279667 | 279895 | 280123 | 280351 | 280578 | 280806 | 228 |
| 191 | 281033 | 281261 | 281488 | 281715 | 281942 | 282169 | 282395 | 282622 | 282849 | 283075 | 227 |
| 192 | 283301 | 283527 | 283753 | 283979 | 284205 | 284431 | 284656 | 284882 | 285107 | 285332 | 226 |
| 193 | 285557 | 285782 | 286007 | 286232 | 286456 | 286681 | 286905 | 287130 | 287354 | 287578 | 225 |
| 194 | 287802 | 288025 | 288249 | 288473 | 288696 | 288920 | 289143 | 289366 | 289589 | 289812 | 223 |
| 195 | 290035 | 290257 | 290480 | 290702 | 290925 | 291147 | 291369 | 291591 | 291813 | 292034 | 222 |
| 196 | 292256 | 292478 | 292699 | 292920 | 293141 | 293363 | 293583 | 293804 | 294025 | 294246 | 221 |
| 197 | 294466 | 294687 | 294907 | 295127 | 295347 | 295567 | 295787 | 296007 | 296226 | 296446 | 220 |
| 198 | 296665 | 296884 | 297104 | 297323 | 297542 | 297761 | 297979 | 298198 | 298416 | 298635 | 219 |
| 199 | 298853 | 299071 | 299289 | 299507 | 299725 | 299943 | 300161 | 300378 | 300595 | 300813 | 218 |
| 200 | 301030 | 301247 | 301464 | 301681 | 301898 | 302114 | 302331 | 302547 | 302764 | 302980 | 217 |
| 201 | 303196 | 303412 | 303628 | 303844 | 304059 | 304275 | 304491 | 304706 | 304921 | 305136 | 216 |
| 202 | 305351 | 305566 | 305781 | 305996 | 306211 | 306425 | 306639 | 306854 | 307068 | 307282 | 214 |
| 203 | 307496 | 307710 | 307924 | 308137 | 308351 | 308564 | 308778 | 308991 | 309204 | 309417 | 213 |
| 204 | 309630 | 309843 | 310056 | 310268 | 310481 | 310693 | 310906 | 311118 | 311330 | 311542 | 212 |
| 205 | 311754 | 311966 | 312177 | 312389 | 312600 | 312812 | 313023 | 313234 | 313445 | 313656 | 211 |
| 206 | 313867 | 314078 | 314289 | 314499 | 314710 | 314920 | 315130 | 315340 | 315550 | 315760 | 210 |
| 207 | 315970 | 316180 | 316390 | 316599 | 316809 | 317018 | 317227 | 317436 | 317645 | 317854 | 209 |
| 208 | 318063 | 318272 | 318481 | 318689 | 318898 | 319106 | 319314 | 319522 | 319730 | 319938 | 208 |
| 209 | 320146 | 320354 | 320562 | 320769 | 320977 | 321184 | 321391 | 321598 | 321805 | 322012 | 207 |
| 210 | 322219 | 322426 | 322633 | 322839 | 323046 | 323252 | 323458 | 323665 | 323871 | 324077 | 206 |
| 211 | 324282 | 324488 | 324694 | 324899 | 325105 | 325310 | 325516 | 325721 | 325926 | 326131 | 205 |
| 212 | 326336 | 326541 | 326745 | 326950 | 327155 | 327359 | 327563 | 327767 | 327972 | 328176 | 204 |
| 213 | 328380 | 328583 | 328787 | 328991 | 329194 | 329398 | 329601 | 329805 | 330008 | 330211 | 203 |
| 214 | 330414 | 330617 | 330819 | 331022 | 331225 | 331427 | 331630 | 331832 | 332034 | 332236 | 202 |
| 215 | 332438 | 332640 | 332842 | 333044 | 333246 | 333447 | 333649 | 333850 | 334051 | 334253 | 202 |
| 216 | 334454 | 334655 | 334856 | 335056 | 335257 | 335458 | 335658 | 335859 | 336059 | 336260 | 201 |
| 217 | 336460 | 336660 | 336860 | 337060 | 337260 | 337459 | 337659 | 337858 | 338058 | 338257 | 200 |
| 218 | 338456 | 338656 | 338855 | 339054 | 339253 | 339451 | 339650 | 339849 | 340047 | 340246 | 199 |
| 219 | 340444 | 340642 | 340841 | 341039 | 341237 | 341435 | 341632 | 341830 | 342028 | 342225 | 198 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 2200——2800 Log. 342423——447158.

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 220 | 342423 | 342620 | 342817 | 343014 | 343212 | 343409 | 343606 | 343802 | 343999 | 344196 | 197 |
| 221 | 344392 | 344589 | 344785 | 344981 | 345178 | 345374 | 345570 | 345766 | 345962 | 346157 | 196 |
| 222 | 346353 | 346549 | 346744 | 346939 | 347135 | 347330 | 347525 | 347720 | 347915 | 348110 | 195 |
| 223 | 348305 | 348500 | 348694 | 348889 | 349083 | 349278 | 349472 | 349666 | 349860 | 350054 | 194 |
| 224 | 350248 | 350442 | 350636 | 350829 | 351023 | 351216 | 351410 | 351603 | 351796 | 351989 | 193 |
| 225 | 352182 | 352375 | 352568 | 352761 | 352954 | 353147 | 353339 | 353532 | 353724 | 353916 | 193 |
| 226 | 354108 | 354301 | 354493 | 354685 | 354876 | 355068 | 355260 | 355452 | 355643 | 355834 | 192 |
| 227 | 356026 | 356217 | 356408 | 356599 | 356790 | 356981 | 357172 | 357363 | 357554 | 357744 | 191 |
| 228 | 357935 | 358125 | 358316 | 358506 | 358696 | 358886 | 359076 | 359266 | 359456 | 359646 | 190 |
| 229 | 359835 | 360025 | 360215 | 360404 | 360593 | 360783 | 360972 | 361161 | 361350 | 361539 | 189 |
| 230 | 361728 | 361917 | 362105 | 362294 | 362482 | 362671 | 362859 | 363048 | 363236 | 363424 | 188 |
| 231 | 363612 | 363800 | 363988 | 364176 | 364363 | 364551 | 364739 | 364926 | 365113 | 365301 | 188 |
| 232 | 365488 | 365675 | 365862 | 366049 | 366236 | 366423 | 366610 | 366796 | 366983 | 367169 | 187 |
| 233 | 367356 | 367542 | 367729 | 367915 | 368101 | 368287 | 368473 | 368659 | 368844 | 369030 | 186 |
| 234 | 369216 | 369401 | 369587 | 369772 | 369958 | 370143 | 370328 | 370513 | 370698 | 370883 | 185 |
| 235 | 371068 | 371253 | 371437 | 371622 | 371806 | 371991 | 372175 | 372360 | 372544 | 372728 | 184 |
| 236 | 372912 | 373096 | 373280 | 373464 | 373647 | 373831 | 374015 | 374198 | 374382 | 374565 | 184 |
| 237 | 374748 | 374932 | 375115 | 375298 | 375481 | 375664 | 375846 | 376029 | 376212 | 376394 | 183 |
| 238 | 376577 | 376759 | 376942 | 377124 | 377306 | 377488 | 377670 | 377852 | 378034 | 378216 | 182 |
| 239 | 378398 | 378580 | 378761 | 378943 | 379124 | 379306 | 379487 | 379668 | 379849 | 380030 | 181 |
| 240 | 380211 | 380392 | 380573 | 380754 | 380934 | 381115 | 381296 | 381476 | 381656 | 381837 | 181 |
| 241 | 382017 | 382197 | 382377 | 382557 | 382737 | 382917 | 383097 | 383277 | 383456 | 383636 | 180 |
| 242 | 383815 | 383995 | 384174 | 384353 | 384533 | 384712 | 384891 | 385070 | 385249 | 385428 | 179 |
| 243 | 385606 | 385785 | 385964 | 386142 | 386321 | 386499 | 386677 | 386856 | 387034 | 387212 | 178 |
| 244 | 387390 | 387568 | 387746 | 387923 | 388101 | 388279 | 388456 | 388634 | 388811 | 388989 | 178 |
| 245 | 389166 | 389343 | 389520 | 389697 | 389875 | 390051 | 390228 | 390405 | 390582 | 390759 | 177 |
| 246 | 390935 | 391112 | 391288 | 391464 | 391641 | 391817 | 391993 | 392169 | 392345 | 392521 | 176 |
| 247 | 392697 | 392873 | 393048 | 393224 | 393400 | 393575 | 393751 | 393926 | 394101 | 394277 | 176 |
| 248 | 394452 | 394627 | 394802 | 394977 | 395152 | 395326 | 395501 | 395676 | 395850 | 396025 | 175 |
| 249 | 396199 | 396374 | 396548 | 396722 | 396896 | 397071 | 397245 | 397418 | 397592 | 397766 | 174 |
| 250 | 397940 | 398114 | 398287 | 398461 | 398634 | 398808 | 398981 | 399154 | 399327 | 399501 | 173 |
| 251 | 399674 | 399847 | 400020 | 400192 | 400365 | 400538 | 400711 | 400883 | 401056 | 401228 | 173 |
| 252 | 401400 | 401573 | 401745 | 401917 | 402089 | 402261 | 402433 | 402605 | 402777 | 402949 | 172 |
| 253 | 403120 | 403292 | 403464 | 403635 | 403807 | 403978 | 404149 | 404320 | 404492 | 404663 | 171 |
| 254 | 404834 | 405005 | 405175 | 405346 | 405517 | 405688 | 405858 | 406029 | 406199 | 406370 | 171 |
| 255 | 406540 | 406710 | 406881 | 407051 | 407221 | 407391 | 407561 | 407731 | 407900 | 408070 | 170 |
| 256 | 408240 | 408410 | 408579 | 408749 | 408918 | 409087 | 409257 | 409426 | 409595 | 409764 | 169 |
| 257 | 409933 | 410102 | 410271 | 410440 | 410608 | 410777 | 410946 | 411114 | 411283 | 411451 | 169 |
| 258 | 411620 | 411788 | 411956 | 412124 | 412292 | 412460 | 412628 | 412796 | 412964 | 413132 | 168 |
| 259 | 413300 | 413467 | 413635 | 413802 | 413970 | 414137 | 414305 | 414472 | 414639 | 414806 | 167 |
| 260 | 414973 | 415140 | 415307 | 415474 | 415641 | 415808 | 415974 | 416141 | 416308 | 416474 | 167 |
| 261 | 416640 | 416807 | 416973 | 417139 | 417306 | 417472 | 417638 | 417804 | 417970 | 418135 | 166 |
| 262 | 418301 | 418467 | 418633 | 418798 | 418964 | 419129 | 419295 | 419460 | 419625 | 419791 | 165 |
| 263 | 419956 | 420121 | 420286 | 420451 | 420616 | 420781 | 420945 | 421110 | 421275 | 421439 | 165 |
| 264 | 421604 | 421768 | 421933 | 422097 | 422261 | 422426 | 422590 | 422754 | 422918 | 423082 | 164 |
| 265 | 423246 | 423410 | 423573 | 423737 | 423901 | 424064 | 424228 | 424392 | 424555 | 424718 | 164 |
| 266 | 424882 | 425045 | 425208 | 425371 | 425534 | 425697 | 425860 | 426023 | 426186 | 426349 | 163 |
| 267 | 426511 | 426674 | 426836 | 426999 | 427161 | 427324 | 427486 | 427648 | 427811 | 427973 | 162 |
| 268 | 428135 | 428297 | 428459 | 428621 | 428782 | 428944 | 429106 | 429268 | 429429 | 429591 | 162 |
| 269 | 429752 | 429914 | 430075 | 430236 | 430398 | 430559 | 430720 | 430881 | 431042 | 431203 | 161 |
| 270 | 431364 | 431525 | 431685 | 431846 | 432007 | 432167 | 432328 | 432488 | 432649 | 432809 | 160 |
| 271 | 432969 | 433129 | 433290 | 433450 | 433610 | 433770 | 433930 | 434090 | 434249 | 434409 | 160 |
| 272 | 434569 | 434728 | 434888 | 435048 | 435207 | 435366 | 435526 | 435685 | 435844 | 436003 | 159 |
| 273 | 436163 | 436322 | 436481 | 436640 | 436798 | 436957 | 437116 | 437275 | 437433 | 437592 | 159 |
| 274 | 437751 | 437909 | 438067 | 438226 | 438384 | 438542 | 438700 | 438859 | 439017 | 439175 | 158 |
| 275 | 439333 | 439491 | 439648 | 439806 | 439964 | 440122 | 440279 | 440437 | 440594 | 440752 | 158 |
| 276 | 440909 | 441066 | 441224 | 441381 | 441538 | 441695 | 441852 | 442009 | 442166 | 442323 | 157 |
| 277 | 442480 | 442636 | 442793 | 442950 | 443106 | 443263 | 443419 | 443576 | 443732 | 443888 | 157 |
| 278 | 444045 | 444201 | 444357 | 444513 | 444669 | 444825 | 444981 | 445137 | 445293 | 445448 | 156 |
| 279 | 445604 | 445760 | 445915 | 446071 | 446226 | 446382 | 446537 | 446692 | 446848 | 447003 | 155 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

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# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 2800——3400 Log. 447158——531479

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 280 | 447158 | 447313 | 447468 | 447623 | 447778 | 447933 | 448088 | 448242 | 448397 | 448552 | 155 |
| 281 | 448706 | 448861 | 449015 | 449170 | 449324 | 449478 | 449633 | 449787 | 449941 | 450095 | 154 |
| 282 | 450249 | 450403 | 450557 | 450711 | 450865 | 451018 | 451172 | 451326 | 451479 | 451633 | 154 |
| 283 | 451786 | 451940 | 452093 | 452247 | 452400 | 452553 | 452706 | 452859 | 453012 | 453165 | 153 |
| 284 | 453318 | 453471 | 453624 | 453777 | 453930 | 454082 | 454235 | 454387 | 454540 | 454692 | 153 |
| 285 | 454845 | 454997 | 455149 | 455302 | 455454 | 455606 | 455758 | 455910 | 456062 | 456214 | 152 |
| 286 | 456366 | 456518 | 456670 | 456821 | 456973 | 457125 | 457276 | 457428 | 457579 | 457730 | 152 |
| 287 | 457882 | 458033 | 458184 | 458336 | 458487 | 458638 | 458789 | 458940 | 459091 | 459242 | 151 |
| 288 | 459392 | 459543 | 459694 | 459845 | 459995 | 460146 | 460296 | 460447 | 460597 | 460747 | 151 |
| 289 | 460898 | 461048 | 461198 | 461348 | 461498 | 461649 | 461799 | 461948 | 462098 | 462248 | 150 |
| 290 | 462398 | 462548 | 462697 | 462847 | 462997 | 463146 | 463296 | 463445 | 463594 | 463744 | 150 |
| 291 | 463893 | 464042 | 464191 | 464340 | 464489 | 464639 | 464787 | 464936 | 465085 | 465234 | 149 |
| 292 | 465383 | 465532 | 465680 | 465829 | 465977 | 466126 | 466274 | 466423 | 466571 | 466719 | 149 |
| 293 | 466868 | 467016 | 467164 | 467312 | 467460 | 467608 | 467756 | 467904 | 468052 | 468200 | 148 |
| 294 | 468347 | 468495 | 468643 | 468790 | 468938 | 469085 | 469233 | 469380 | 469527 | 469675 | 148 |
| 295 | 469822 | 469969 | 470116 | 470263 | 470410 | 470557 | 470704 | 470851 | 470998 | 471145 | 147 |
| 296 | 471292 | 471438 | 471585 | 471732 | 471878 | 472025 | 472171 | 472317 | 472464 | 472610 | 147 |
| 297 | 472756 | 472903 | 473049 | 473195 | 473341 | 473487 | 473633 | 473779 | 473925 | 474070 | 146 |
| 298 | 474216 | 474362 | 474508 | 474653 | 474799 | 474944 | 475090 | 475235 | 475381 | 475526 | 146 |
| 299 | 475671 | 475816 | 475962 | 476107 | 476252 | 476397 | 476542 | 476687 | 476832 | 476976 | 145 |
| 300 | 477121 | 477266 | 477411 | 477555 | 477700 | 477844 | 477989 | 478133 | 478278 | 478422 | 145 |
| 301 | 478566 | 478711 | 478855 | 478999 | 479143 | 479287 | 479431 | 479575 | 479719 | 479863 | 144 |
| 302 | 480007 | 480151 | 480294 | 480438 | 480582 | 480725 | 480869 | 481012 | 481156 | 481299 | 141 |
| 303 | 481443 | 481586 | 481729 | 481872 | 482016 | 482159 | 482302 | 482445 | 482588 | 482731 | 143 |
| 304 | 482874 | 483016 | 483159 | 483302 | 483445 | 483587 | 483730 | 483872 | 484015 | 484157 | 143 |
| 305 | 484300 | 484442 | 484584 | 484727 | 484869 | 485011 | 485153 | 485295 | 485437 | 485579 | 142 |
| 306 | 485721 | 485863 | 486005 | 486147 | 486289 | 486430 | 486572 | 486714 | 486855 | 486997 | 142 |
| 307 | 487138 | 487280 | 487421 | 487563 | 487704 | 487845 | 487986 | 488127 | 488269 | 488410 | 141 |
| 308 | 488551 | 488692 | 488833 | 488973 | 489114 | 489255 | 489396 | 489537 | 489677 | 489818 | 141 |
| 309 | 489958 | 490099 | 490239 | 490380 | 490520 | 490661 | 490801 | 490941 | 491081 | 491222 | 140 |
| 310 | 491362 | 491502 | 491642 | 491782 | 491922 | 492062 | 492201 | 492341 | 492481 | 492621 | 140 |
| 311 | 492760 | 492900 | 493040 | 493179 | 493319 | 493458 | 493597 | 493737 | 493876 | 494015 | 139 |
| 312 | 494155 | 494294 | 494433 | 494572 | 494711 | 494850 | 494989 | 495128 | 495267 | 495406 | 139 |
| 313 | 495544 | 495683 | 495822 | 495960 | 496099 | 496237 | 496376 | 496514 | 496653 | 496791 | 139 |
| 314 | 496930 | 497068 | 497206 | 497344 | 497482 | 497621 | 497759 | 497897 | 498035 | 498173 | 138 |
| 315 | 498311 | 498448 | 498586 | 498724 | 498862 | 498999 | 499137 | 499275 | 499412 | 499550 | 138 |
| 316 | 499687 | 499824 | 499962 | 500099 | 500236 | 500374 | 500511 | 500648 | 500785 | 500922 | 137 |
| 317 | 501059 | 501196 | 501333 | 501470 | 501607 | 501744 | 501880 | 502017 | 502154 | 502290 | 137 |
| 318 | 502427 | 502564 | 502700 | 502837 | 502973 | 503109 | 503246 | 503382 | 503518 | 503654 | 136 |
| 319 | 503791 | 503927 | 504063 | 504199 | 504335 | 504471 | 504607 | 504743 | 504878 | 505014 | 136 |
| 320 | 505150 | 505286 | 505421 | 505557 | 505692 | 505828 | 505963 | 506099 | 506234 | 506370 | 136 |
| 321 | 506505 | 506640 | 506775 | 506911 | 507046 | 507181 | 507316 | 507451 | 507586 | 507721 | 135 |
| 322 | 507856 | 507991 | 508125 | 508260 | 508395 | 508530 | 508664 | 508799 | 508933 | 509068 | 135 |
| 323 | 509202 | 509337 | 509471 | 509606 | 509740 | 509874 | 510008 | 510143 | 510277 | 510411 | 134 |
| 324 | 510545 | 510679 | 510813 | 510947 | 511081 | 511215 | 511348 | 511482 | 511616 | 511750 | 134 |
| 325 | 511883 | 512017 | 512150 | 512284 | 512417 | 512551 | 512684 | 512818 | 512951 | 513084 | 133 |
| 326 | 513218 | 513351 | 513484 | 513617 | 513750 | 513883 | 514016 | 514149 | 514282 | 514415 | 133 |
| 327 | 514548 | 514680 | 514813 | 514946 | 515079 | 515211 | 515344 | 515476 | 515609 | 515741 | 133 |
| 328 | 515874 | 516006 | 516139 | 516271 | 516403 | 516535 | 516668 | 516800 | 516932 | 517064 | 132 |
| 329 | 517196 | 517328 | 517460 | 517592 | 517724 | 517855 | 517987 | 518119 | 518251 | 518382 | 132 |
| 330 | 518514 | 518645 | 518777 | 518909 | 519040 | 519171 | 519303 | 519434 | 519565 | 519697 | 131 |
| 331 | 519828 | 519959 | 520090 | 520221 | 520352 | 520483 | 520614 | 520745 | 520876 | 521007 | 131 |
| 332 | 521138 | 521269 | 521400 | 521530 | 521661 | 521792 | 521922 | 522053 | 522183 | 522314 | 131 |
| 333 | 522444 | 522575 | 522705 | 522835 | 522966 | 523096 | 523226 | 523356 | 523486 | 523616 | 130 |
| 334 | 523746 | 523876 | 524006 | 524136 | 524266 | 524396 | 524526 | 524656 | 524785 | 524915 | 130 |
| 335 | 525045 | 525174 | 525304 | 525434 | 525563 | 525693 | 525822 | 525951 | 526081 | 526210 | 129 |
| 336 | 526339 | 526468 | 526598 | 526727 | 526856 | 526985 | 527114 | 527243 | 527372 | 527501 | 129 |
| 337 | 527630 | 527759 | 527888 | 528016 | 528145 | 528274 | 528402 | 528531 | 528660 | 528788 | 129 |
| 338 | 528917 | 529045 | 529174 | 529302 | 529430 | 529559 | 529687 | 529815 | 529943 | 530072 | 128 |
| 339 | 530200 | 530328 | 530456 | 530584 | 530712 | 530840 | 530968 | 531095 | 531223 | 531351 | 128 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

LOGARITHMS OF NUMBERS.

No. 3400———4000 Log. 531479———602060

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 340 | 531479 | 531607 | 531734 | 531862 | 531990 | 532117 | 532245 | 532372 | 532500 | 532627 | 128 |
| 341 | 532754 | 532882 | 533009 | 533136 | 533263 | 533391 | 533518 | 533645 | 533772 | 533899 | 127 |
| 342 | 534026 | 534153 | 534280 | 534407 | 534534 | 534661 | 534787 | 534914 | 535041 | 535167 | 127 |
| 343 | 535294 | 535421 | 535547 | 535674 | 535800 | 535927 | 536053 | 536179 | 536306 | 536432 | 126 |
| 344 | 536558 | 536685 | 536811 | 536937 | 537063 | 537189 | 537315 | 537441 | 537567 | 537693 | 126 |
| 345 | 537819 | 537945 | 538071 | 538197 | 538322 | 538448 | 538574 | 538699 | 538825 | 538951 | 126 |
| 346 | 539076 | 539202 | 539327 | 539452 | 539578 | 539703 | 539829 | 539954 | 540079 | 540204 | 125 |
| 347 | 540329 | 540455 | 540580 | 540705 | 540830 | 540955 | 541080 | 541205 | 541330 | 541454 | 125 |
| 348 | 541579 | 541704 | 541829 | 541953 | 542078 | 542203 | 542327 | 542452 | 542576 | 542701 | 125 |
| 349 | 542825 | 542950 | 543074 | 543199 | 543323 | 543447 | 543571 | 543696 | 543820 | 543944 | 124 |
| 350 | 544068 | 544192 | 544316 | 544440 | 544564 | 544688 | 544812 | 544936 | 545060 | 545183 | 124 |
| 351 | 545307 | 545431 | 545554 | 545678 | 545802 | 545925 | 546049 | 546172 | 546296 | 546419 | 124 |
| 352 | 546543 | 546666 | 546789 | 546913 | 547036 | 547159 | 547282 | 547405 | 547529 | 547652 | 123 |
| 353 | 547775 | 547898 | 548021 | 548144 | 548266 | 548389 | 548512 | 548635 | 548758 | 548881 | 123 |
| 354 | 549003 | 549126 | 549249 | 549371 | 549494 | 549616 | 549739 | 549861 | 549984 | 550106 | 123 |
| 355 | 550228 | 550351 | 550473 | 550595 | 550717 | 550840 | 550962 | 551084 | 551206 | 551328 | 122 |
| 356 | 551450 | 551572 | 551694 | 551816 | 551938 | 552059 | 552181 | 552303 | 552425 | 552546 | 122 |
| 357 | 552668 | 552790 | 552911 | 553033 | 553154 | 553276 | 553398 | 553519 | 553640 | 553762 | 121 |
| 358 | 553883 | 554004 | 554126 | 554247 | 554368 | 554489 | 554610 | 554731 | 554852 | 554973 | 121 |
| 359 | 555094 | 555215 | 555336 | 555457 | 555578 | 555699 | 555820 | 555940 | 556061 | 556182 | 121 |
| 360 | 556302 | 556423 | 556544 | 556664 | 556785 | 556905 | 557026 | 557146 | 557267 | 557387 | 120 |
| 361 | 557507 | 557627 | 557748 | 557868 | 557988 | 558108 | 558228 | 558348 | 558469 | 558589 | 120 |
| 362 | 558709 | 558829 | 558948 | 559068 | 559188 | 559308 | 559428 | 559548 | 559667 | 559787 | 120 |
| 363 | 559907 | 560026 | 560146 | 560265 | 560385 | 560504 | 560624 | 560743 | 560863 | 560982 | 119 |
| 364 | 561101 | 561221 | 561340 | 561459 | 561578 | 561698 | 561817 | 561936 | 562055 | 562174 | 119 |
| 365 | 562293 | 562412 | 562531 | 562650 | 562769 | 562887 | 563006 | 563125 | 563244 | 563362 | 119 |
| 366 | 563481 | 563600 | 563718 | 563837 | 563955 | 564074 | 564192 | 564311 | 564429 | 564548 | 119 |
| 367 | 564666 | 564784 | 564903 | 565021 | 565139 | 565257 | 565376 | 565494 | 565612 | 565730 | 118 |
| 368 | 565848 | 565966 | 566084 | 566202 | 566320 | 566437 | 566555 | 566673 | 566791 | 566909 | 118 |
| 369 | 567026 | 567144 | 567262 | 567379 | 567497 | 567614 | 567732 | 567849 | 567967 | 568084 | 118 |
| 370 | 568202 | 568319 | 568436 | 568554 | 568671 | 568788 | 568905 | 569023 | 569140 | 569257 | 117 |
| 371 | 569374 | 569491 | 569608 | 569725 | 569842 | 569959 | 570076 | 570193 | 570309 | 570426 | 117 |
| 372 | 570543 | 570660 | 570776 | 570893 | 571010 | 571126 | 571243 | 571359 | 571476 | 571592 | 117 |
| 373 | 571709 | 571825 | 571942 | 572058 | 572174 | 572291 | 572407 | 572523 | 572639 | 572755 | 116 |
| 374 | 572872 | 572988 | 573104 | 573220 | 573336 | 573452 | 573568 | 573684 | 573800 | 573915 | 116 |
| 375 | 574031 | 574147 | 574263 | 574379 | 574494 | 574610 | 574726 | 574841 | 574957 | 575072 | 116 |
| 376 | 575188 | 575303 | 575419 | 575534 | 575650 | 575765 | 575880 | 575996 | 576111 | 576226 | 115 |
| 377 | 576341 | 576457 | 576572 | 576687 | 576802 | 576917 | 577032 | 577147 | 577262 | 577377 | 115 |
| 378 | 577492 | 577607 | 577721 | 577836 | 577951 | 578066 | 578181 | 578295 | 578410 | 578525 | 115 |
| 379 | 578639 | 578754 | 578868 | 578983 | 579097 | 579212 | 579326 | 579441 | 579555 | 579669 | 114 |
| 380 | 579784 | 579898 | 580012 | 580126 | 580240 | 580355 | 580469 | 580583 | 580697 | 580811 | 114 |
| 381 | 580925 | 581039 | 581153 | 581267 | 581381 | 581495 | 581608 | 581722 | 581836 | 581950 | 114 |
| 382 | 582063 | 582177 | 582291 | 582404 | 582518 | 582631 | 582745 | 582858 | 582972 | 583085 | 114 |
| 383 | 583199 | 583312 | 583426 | 583539 | 583652 | 583765 | 583879 | 583992 | 584105 | 584218 | 113 |
| 384 | 584331 | 584444 | 584557 | 584670 | 584783 | 584896 | 585009 | 585122 | 585235 | 585348 | 113 |
| 385 | 585461 | 585574 | 585686 | 585799 | 585912 | 586024 | 586137 | 586250 | 586362 | 586475 | 113 |
| 386 | 586587 | 586700 | 586812 | 586925 | 587037 | 587149 | 587262 | 587374 | 587486 | 587599 | 112 |
| 387 | 587711 | 587823 | 587935 | 588047 | 588160 | 588272 | 588384 | 588496 | 588608 | 588720 | 112 |
| 388 | 588832 | 588944 | 589056 | 589167 | 589279 | 589391 | 589503 | 589615 | 589726 | 589838 | 112 |
| 389 | 589950 | 590061 | 590173 | 590284 | 590396 | 590507 | 590619 | 590730 | 590842 | 590953 | 112 |
| 390 | 591065 | 591176 | 591287 | 591399 | 591510 | 591621 | 591732 | 591843 | 591955 | 592066 | 111 |
| 391 | 592177 | 592288 | 592399 | 592510 | 592621 | 592732 | 592843 | 592954 | 593064 | 593175 | 111 |
| 392 | 593286 | 593397 | 593508 | 593618 | 593729 | 593840 | 593950 | 594061 | 594171 | 594282 | 111 |
| 393 | 594393 | 594503 | 594613 | 594724 | 594834 | 594945 | 595055 | 595165 | 595276 | 595386 | 110 |
| 394 | 595496 | 595606 | 595717 | 595827 | 595937 | 596047 | 596157 | 596267 | 596377 | 596487 | 110 |
| 395 | 596597 | 596707 | 596817 | 596927 | 597037 | 597146 | 597256 | 597366 | 597476 | 597585 | 110 |
| 396 | 597695 | 597805 | 597914 | 598024 | 598134 | 598243 | 598353 | 598462 | 598572 | 598681 | 110 |
| 397 | 598790 | 598900 | 599009 | 599119 | 599228 | 599337 | 599446 | 599556 | 599665 | 599774 | 109 |
| 398 | 599883 | 599992 | 600101 | 600210 | 600319 | 600428 | 600537 | 600646 | 600755 | 600864 | 109 |
| 399 | 600973 | 601082 | 601190 | 601299 | 601408 | 601517 | 601625 | 601734 | 601843 | 601951 | 109 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 4000———4600 Log. 602060———662758

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 400 | 602060 | 602169 | 602277 | 602386 | 602494 | 602603 | 602711 | 602819 | 602928 | 603036 | 108 |
| 401 | 603144 | 603253 | 603361 | 603469 | 603577 | 603686 | 603794 | 603902 | 604010 | 604118 | 108 |
| 402 | 604226 | 604334 | 604442 | 604550 | 604658 | 604766 | 604874 | 604982 | 605089 | 605197 | 108 |
| 403 | 605305 | 605413 | 605521 | 605628 | 605736 | 605844 | 605951 | 606059 | 606166 | 606274 | 108 |
| 404 | 606381 | 606489 | 606596 | 606704 | 606811 | 606919 | 607026 | 607133 | 607241 | 607348 | 107 |
| 405 | 607455 | 607562 | 607669 | 607777 | 607884 | 607991 | 608098 | 608205 | 608312 | 608419 | 107 |
| 406 | 608526 | 608633 | 608740 | 608847 | 608954 | 609061 | 609167 | 609274 | 609381 | 609488 | 107 |
| 407 | 609594 | 609701 | 609808 | 609914 | 610021 | 610128 | 610234 | 610341 | 610447 | 610554 | 107 |
| 408 | 610660 | 610767 | 610873 | 610979 | 611086 | 611192 | 611298 | 611405 | 611511 | 611617 | 106 |
| 409 | 611723 | 611829 | 611936 | 612042 | 612148 | 612254 | 612360 | 612466 | 612572 | 612678 | 106 |
| 410 | 612784 | 612890 | 612996 | 613101 | 613207 | 613313 | 613419 | 613525 | 613630 | 613736 | 106 |
| 411 | 613842 | 613947 | 614053 | 614159 | 614264 | 614370 | 614475 | 614581 | 614686 | 614792 | 106 |
| 412 | 614897 | 615003 | 615108 | 615213 | 615319 | 615424 | 615529 | 615634 | 615740 | 615845 | 105 |
| 413 | 615950 | 616055 | 616160 | 616265 | 616370 | 616475 | 616580 | 616685 | 616790 | 616895 | 105 |
| 414 | 617000 | 617105 | 617210 | 617315 | 617420 | 617524 | 617629 | 617734 | 617839 | 617943 | 105 |
| 415 | 618048 | 618153 | 618257 | 618362 | 618466 | 618571 | 618675 | 618780 | 618884 | 618989 | 105 |
| 416 | 619093 | 619198 | 619302 | 619406 | 619511 | 619615 | 619719 | 619823 | 619928 | 620032 | 104 |
| 417 | 620136 | 620240 | 620344 | 620448 | 620552 | 620656 | 620760 | 620864 | 620968 | 621072 | 104 |
| 418 | 621176 | 621280 | 621384 | 621488 | 621592 | 621695 | 621799 | 621903 | 622007 | 622110 | 104 |
| 419 | 622214 | 622318 | 622421 | 622525 | 622628 | 622732 | 622835 | 622939 | 623042 | 623146 | 104 |
| 420 | 623249 | 623353 | 623456 | 623559 | 623663 | 623766 | 623869 | 623972 | 624076 | 624179 | 103 |
| 421 | 624282 | 624385 | 624488 | 624591 | 624694 | 624798 | 624901 | 625004 | 625107 | 625209 | 103 |
| 422 | 625312 | 625415 | 625518 | 625621 | 625724 | 625827 | 625929 | 626032 | 626135 | 626238 | 103 |
| 423 | 626340 | 626443 | 626546 | 626648 | 626751 | 626853 | 626956 | 627058 | 627161 | 627263 | 103 |
| 424 | 627366 | 627468 | 627571 | 627673 | 627775 | 627878 | 627980 | 628082 | 628184 | 628287 | 102 |
| 425 | 628389 | 628491 | 628593 | 628695 | 628797 | 628900 | 629002 | 629104 | 629206 | 629308 | 102 |
| 426 | 629410 | 629511 | 629613 | 629715 | 629817 | 629919 | 630021 | 630123 | 630224 | 630326 | 102 |
| 427 | 630428 | 630530 | 630631 | 630733 | 630834 | 630936 | 631038 | 631139 | 631241 | 631342 | 102 |
| 428 | 631444 | 631545 | 631647 | 631748 | 631849 | 631951 | 632052 | 632153 | 632255 | 632356 | 101 |
| 429 | 632457 | 632558 | 632660 | 632761 | 632862 | 632963 | 633064 | 633165 | 633266 | 633367 | 101 |
| 430 | 633468 | 633569 | 633670 | 633771 | 633872 | 633973 | 634074 | 634175 | 634276 | 634376 | 101 |
| 431 | 634477 | 634578 | 634679 | 634779 | 634880 | 634981 | 635081 | 635182 | 635283 | 635383 | 101 |
| 432 | 635484 | 635584 | 635685 | 635785 | 635886 | 635986 | 636086 | 636187 | 636287 | 636388 | 100 |
| 433 | 636488 | 636588 | 636688 | 636789 | 636889 | 636989 | 637089 | 637189 | 637289 | 637390 | 100 |
| 434 | 637490 | 637590 | 637690 | 637790 | 637890 | 637990 | 638090 | 638190 | 638289 | 638389 | 100 |
| 435 | 638489 | 638589 | 638689 | 638789 | 638888 | 638988 | 639088 | 639188 | 639287 | 639387 | 100 |
| 436 | 639486 | 639586 | 639686 | 639785 | 639885 | 639984 | 640084 | 640183 | 640283 | 640382 | 99 |
| 437 | 640481 | 640581 | 640680 | 640779 | 640879 | 640978 | 641077 | 641176 | 641276 | 641375 | 99 |
| 438 | 641474 | 641573 | 641672 | 641771 | 641870 | 641970 | 642069 | 642168 | 642267 | 642366 | 99 |
| 439 | 642464 | 642563 | 642662 | 642761 | 642860 | 642959 | 643058 | 643156 | 643255 | 643354 | 99 |
| 440 | 643453 | 643551 | 643650 | 643749 | 643847 | 643946 | 644044 | 644143 | 644242 | 644340 | 98 |
| 441 | 644439 | 644537 | 644635 | 644734 | 644832 | 644931 | 645029 | 645127 | 645226 | 645324 | 98 |
| 442 | 645422 | 645520 | 645619 | 645717 | 645815 | 645913 | 646011 | 646109 | 646208 | 646306 | 98 |
| 443 | 646404 | 646502 | 646600 | 646698 | 646796 | 646894 | 646991 | 647089 | 647187 | 647285 | 98 |
| 444 | 647383 | 647481 | 647579 | 647676 | 647774 | 647872 | 647969 | 648067 | 648165 | 648262 | 98 |
| 445 | 648360 | 648458 | 648555 | 648653 | 648750 | 648848 | 648945 | 649043 | 649140 | 649237 | 97 |
| 446 | 649335 | 649432 | 649530 | 649627 | 649724 | 649821 | 649919 | 650016 | 650113 | 650210 | 97 |
| 447 | 650307 | 650405 | 650502 | 650599 | 650696 | 650793 | 650890 | 650987 | 651084 | 651181 | 97 |
| 448 | 651278 | 651375 | 651472 | 651569 | 651666 | 651762 | 651859 | 651956 | 652053 | 652150 | 97 |
| 449 | 652246 | 652343 | 652440 | 652536 | 652633 | 652730 | 652826 | 652923 | 653019 | 653116 | 97 |
| 450 | 653213 | 653309 | 653405 | 653502 | 653598 | 653695 | 653791 | 653888 | 653984 | 654080 | 96 |
| 451 | 654176 | 654273 | 654369 | 654465 | 654562 | 654658 | 654754 | 654850 | 654946 | 655042 | 96 |
| 452 | 655138 | 655234 | 655331 | 655427 | 655523 | 655619 | 655714 | 655810 | 655906 | 656002 | 96 |
| 453 | 656098 | 656194 | 656290 | 656386 | 656481 | 656577 | 656673 | 656769 | 656864 | 656960 | 96 |
| 454 | 657056 | 657151 | 657247 | 657343 | 657438 | 657534 | 657629 | 657725 | 657820 | 657916 | 96 |
| 455 | 658011 | 658107 | 658202 | 658298 | 658393 | 658488 | 658584 | 658679 | 658774 | 658870 | 95 |
| 456 | 658965 | 659060 | 659155 | 659250 | 659346 | 659441 | 659536 | 659631 | 659726 | 659821 | 95 |
| 457 | 659916 | 660011 | 660106 | 660201 | 660296 | 660391 | 660486 | 660581 | 660676 | 660771 | 95 |
| 458 | 660865 | 660960 | 661055 | 661150 | 661245 | 661339 | 661434 | 661529 | 661623 | 661718 | 95 |
| 459 | 661813 | 661907 | 662002 | 662096 | 662191 | 662286 | 662380 | 662474 | 662569 | 662663 | 95 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 4600———5200 Log. 662758———716003.

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 460 | 662758 | 662852 | 662947 | 663041 | 663135 | 663230 | 663324 | 663418 | 663512 | 663607 | 94 |
| 461 | 663701 | 663795 | 663889 | 663983 | 664078 | 664172 | 664266 | 664360 | 664454 | 664548 | 94 |
| 462 | 664642 | 664736 | 664830 | 664924 | 665018 | 665112 | 665206 | 665299 | 665393 | 665487 | 94 |
| 463 | 665581 | 665675 | 665769 | 665862 | 665956 | 666050 | 666143 | 666237 | 666331 | 666424 | 94 |
| 464 | 666518 | 666612 | 666705 | 666799 | 666892 | 666986 | 667079 | 667173 | 667266 | 667359 | 94 |
| 465 | 667453 | 667546 | 667640 | 667733 | 667826 | 667920 | 668013 | 668106 | 668199 | 668293 | 93 |
| 466 | 668386 | 668479 | 668572 | 668665 | 668758 | 668852 | 668945 | 669038 | 669131 | 669224 | 93 |
| 467 | 669317 | 669410 | 669503 | 669596 | 669689 | 669782 | 669875 | 669967 | 670060 | 670153 | 93 |
| 468 | 670246 | 670339 | 670431 | 670524 | 670617 | 670710 | 670802 | 670895 | 670988 | 671080 | 93 |
| 469 | 671173 | 671265 | 671358 | 671451 | 671543 | 671636 | 671728 | 671821 | 671913 | 672005 | 93 |
| 470 | 672098 | 672190 | 672283 | 672375 | 672467 | 672560 | 672652 | 672744 | 672836 | 672929 | 92 |
| 471 | 673021 | 673113 | 673205 | 673297 | 673390 | 673482 | 673574 | 673666 | 673758 | 673850 | 92 |
| 472 | 673942 | 674034 | 674126 | 674218 | 674310 | 674402 | 674494 | 674586 | 674677 | 674769 | 92 |
| 473 | 674861 | 674953 | 675045 | 675136 | 675228 | 675320 | 675412 | 675503 | 675595 | 675687 | 92 |
| 474 | 675778 | 675870 | 675962 | 676053 | 676145 | 676236 | 676328 | 676419 | 676511 | 676602 | 92 |
| 475 | 676694 | 676785 | 676876 | 676968 | 677059 | 677151 | 677242 | 677333 | 677424 | 677516 | 91 |
| 476 | 677607 | 677698 | 677789 | 677881 | 677972 | 678063 | 678154 | 678245 | 678336 | 678427 | 91 |
| 477 | 678518 | 678609 | 678700 | 678791 | 678882 | 678973 | 679064 | 679155 | 679246 | 679337 | 91 |
| 478 | 679428 | 679519 | 679610 | 679700 | 679791 | 679882 | 679973 | 680063 | 680154 | 680245 | 91 |
| 479 | 680335 | 680426 | 680517 | 680607 | 680698 | 680789 | 680879 | 680970 | 681060 | 681151 | 91 |
| 480 | 681241 | 681332 | 681422 | 681513 | 681603 | 681693 | 681784 | 681874 | 681964 | 682055 | 90 |
| 481 | 682145 | 682235 | 682326 | 682416 | 682506 | 682596 | 682686 | 682777 | 682867 | 682957 | 90 |
| 482 | 683047 | 683137 | 683227 | 683317 | 683407 | 683497 | 683587 | 683677 | 683767 | 683857 | 90 |
| 483 | 683947 | 684037 | 684127 | 684217 | 684307 | 684396 | 684486 | 684576 | 684666 | 684756 | 90 |
| 484 | 684845 | 684935 | 685025 | 685114 | 685204 | 685294 | 685383 | 685473 | 685563 | 685652 | 90 |
| 485 | 685742 | 685831 | 685921 | 686010 | 686100 | 686189 | 686279 | 686368 | 686457 | 686547 | 89 |
| 486 | 686636 | 686726 | 686815 | 686904 | 686994 | 687083 | 687172 | 687261 | 687351 | 687440 | 89 |
| 487 | 687529 | 687618 | 687707 | 687796 | 687886 | 687975 | 688064 | 688153 | 688242 | 688331 | 89 |
| 488 | 688420 | 688509 | 688598 | 688687 | 688776 | 688865 | 688953 | 689042 | 689131 | 689220 | 89 |
| 489 | 689309 | 689398 | 689486 | 689575 | 689664 | 689753 | 689841 | 689930 | 690019 | 690107 | 89 |
| 490 | 690196 | 690285 | 690373 | 690462 | 690550 | 690639 | 690727 | 690816 | 690905 | 690993 | 89 |
| 491 | 691081 | 691170 | 691258 | 691347 | 691435 | 691524 | 691612 | 691700 | 691789 | 691877 | 88 |
| 492 | 691965 | 692053 | 692142 | 692230 | 692318 | 692406 | 692494 | 692583 | 692671 | 692759 | 88 |
| 493 | 692847 | 692935 | 693023 | 693111 | 693199 | 693287 | 693375 | 693463 | 693551 | 693639 | 88 |
| 494 | 693727 | 693815 | 693903 | 693991 | 694078 | 694166 | 694254 | 694342 | 694430 | 694517 | 88 |
| 495 | 694605 | 694693 | 694781 | 694868 | 694956 | 695044 | 695131 | 695219 | 695307 | 695394 | 88 |
| 496 | 695482 | 695569 | 695657 | 695744 | 695832 | 695919 | 696007 | 696094 | 696182 | 696269 | 87 |
| 497 | 696356 | 696444 | 696531 | 696618 | 696706 | 696793 | 696880 | 696968 | 697055 | 697142 | 87 |
| 498 | 697229 | 697317 | 697404 | 697491 | 697578 | 697665 | 697752 | 697839 | 697926 | 698013 | 87 |
| 499 | 698100 | 698188 | 698275 | 698362 | 698448 | 698535 | 698622 | 698709 | 698796 | 698883 | 87 |
| 500 | 698970 | 699057 | 699144 | 699231 | 699317 | 699404 | 699491 | 699578 | 699664 | 699751 | 87 |
| 501 | 699838 | 699924 | 700011 | 700098 | 700184 | 700271 | 700358 | 700444 | 700531 | 700617 | 87 |
| 502 | 700704 | 700790 | 700877 | 700963 | 701050 | 701136 | 701222 | 701309 | 701395 | 701482 | 86 |
| 503 | 701568 | 701654 | 701741 | 701827 | 701913 | 701999 | 702086 | 702172 | 702258 | 702344 | 86 |
| 504 | 702430 | 702517 | 702603 | 702689 | 702775 | 702861 | 702947 | 703033 | 703119 | 703205 | 86 |
| 505 | 703291 | 703377 | 703463 | 703549 | 703635 | 703721 | 703807 | 703893 | 703979 | 704065 | 86 |
| 506 | 704150 | 704236 | 704322 | 704408 | 704494 | 704579 | 704665 | 704751 | 704837 | 704922 | 86 |
| 507 | 705008 | 705094 | 705179 | 705265 | 705350 | 705436 | 705522 | 705607 | 705693 | 705778 | 86 |
| 508 | 705864 | 705949 | 706035 | 706120 | 706206 | 706291 | 706376 | 706462 | 706547 | 706632 | 85 |
| 509 | 706718 | 706803 | 706888 | 706974 | 707059 | 707144 | 707229 | 707315 | 707400 | 707485 | 85 |
| 510 | 707570 | 707655 | 707740 | 707826 | 707911 | 707996 | 708081 | 708166 | 708251 | 708336 | 85 |
| 511 | 708421 | 708506 | 708591 | 708676 | 708761 | 708846 | 708931 | 709015 | 709100 | 709185 | 85 |
| 512 | 709270 | 709355 | 709440 | 709524 | 709609 | 709694 | 709779 | 709863 | 709948 | 710033 | 85 |
| 513 | 710117 | 710202 | 710287 | 710371 | 710456 | 710540 | 710625 | 710710 | 710794 | 710879 | 85 |
| 514 | 710963 | 711048 | 711132 | 711216 | 711301 | 711385 | 711470 | 711554 | 711638 | 711723 | 84 |
| 515 | 711807 | 711892 | 711976 | 712060 | 712144 | 712229 | 712313 | 712397 | 712481 | 712566 | 84 |
| 516 | 712650 | 712734 | 712818 | 712902 | 712986 | 713070 | 713154 | 713238 | 713322 | 713406 | 84 |
| 517 | 713490 | 713574 | 713658 | 713742 | 713826 | 713910 | 713994 | 714078 | 714162 | 714246 | 84 |
| 518 | 714330 | 714414 | 714497 | 714581 | 714665 | 714749 | 714832 | 714916 | 715000 | 715084 | 84 |
| 519 | 715167 | 715251 | 715335 | 715418 | 715502 | 715586 | 715669 | 715753 | 715836 | 715920 | 84 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 5200———5800 Log. 716003———763428

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 520 | 716003 | 716087 | 716170 | 716254 | 716337 | 716421 | 716504 | 716588 | 716671 | 716754 | 83 |
| 521 | 716838 | 716921 | 717004 | 717088 | 717171 | 717254 | 717338 | 717421 | 717504 | 717587 | 83 |
| 522 | 717671 | 717754 | 717837 | 717920 | 718003 | 718086 | 718169 | 718253 | 718336 | 718419 | 83 |
| 523 | 718502 | 718585 | 718668 | 718751 | 718834 | 718917 | 719000 | 719083 | 719165 | 719248 | 83 |
| 524 | 719331 | 719414 | 719497 | 719580 | 719663 | 719745 | 719828 | 719911 | 719994 | 720077 | 83 |
| 525 | 720159 | 720242 | 720325 | 720407 | 720490 | 720573 | 720655 | 720738 | 720821 | 720903 | 83 |
| 526 | 720986 | 721068 | 721151 | 721233 | 721316 | 721398 | 721481 | 721563 | 721646 | 721728 | 82 |
| 527 | 721811 | 721893 | 721975 | 722058 | 722140 | 722222 | 722305 | 722387 | 722469 | 722552 | 82 |
| 528 | 722634 | 722716 | 722798 | 722881 | 722963 | 723045 | 723127 | 723209 | 723291 | 723374 | 82 |
| 529 | 723456 | 723538 | 723620 | 723702 | 723784 | 723866 | 723948 | 724030 | 724112 | 724194 | 82 |
| 530 | 724276 | 724358 | 724440 | 724522 | 724603 | 724685 | 724767 | 724849 | 724931 | 725013 | 82 |
| 531 | 725095 | 725176 | 725258 | 725340 | 725422 | 725503 | 725585 | 725667 | 725748 | 725830 | 82 |
| 532 | 725912 | 725993 | 726075 | 726156 | 726238 | 726320 | 726401 | 726483 | 726564 | 726646 | 82 |
| 533 | 726727 | 726809 | 726890 | 726972 | 727053 | 727134 | 727216 | 727297 | 727379 | 727460 | 81 |
| 534 | 727541 | 727623 | 727704 | 727785 | 727866 | 727948 | 728029 | 728110 | 728191 | 728273 | 81 |
| 535 | 728354 | 728435 | 728516 | 728597 | 728678 | 728759 | 728841 | 728922 | 729003 | 729084 | 81 |
| 536 | 729165 | 729246 | 729327 | 729408 | 729489 | 729570 | 729651 | 729732 | 729813 | 729893 | 81 |
| 537 | 729974 | 730055 | 730136 | 730217 | 730298 | 730378 | 730459 | 730540 | 730621 | 730702 | 81 |
| 538 | 730782 | 730863 | 730944 | 731024 | 731105 | 731186 | 731266 | 731347 | 731428 | 731508 | 81 |
| 539 | 731589 | 731669 | 731750 | 731830 | 731911 | 731991 | 732072 | 732152 | 732233 | 732313 | 81 |
| 540 | 732394 | 732474 | 732555 | 732635 | 732715 | 732796 | 732876 | 732956 | 733037 | 733117 | 80 |
| 541 | 733197 | 733278 | 733358 | 733438 | 733518 | 733598 | 733679 | 733759 | 733839 | 733919 | 80 |
| 542 | 733999 | 734079 | 734159 | 734240 | 734320 | 734400 | 734480 | 734560 | 734640 | 734720 | 80 |
| 543 | 734800 | 734880 | 734960 | 735040 | 735120 | 735200 | 735279 | 735359 | 735439 | 735519 | 80 |
| 544 | 735599 | 735679 | 735759 | 735838 | 735918 | 735998 | 736078 | 736157 | 736237 | 736317 | 80 |
| 545 | 736396 | 736476 | 736556 | 736635 | 736715 | 736795 | 736874 | 736954 | 737034 | 737113 | 80 |
| 546 | 737193 | 737272 | 737352 | 737431 | 737511 | 737590 | 737670 | 737749 | 737829 | 737908 | 79 |
| 547 | 737987 | 738067 | 738146 | 738225 | 738305 | 738384 | 738463 | 738543 | 738622 | 738701 | 79 |
| 548 | 738781 | 738860 | 738939 | 739018 | 739097 | 739177 | 739256 | 739335 | 739414 | 739493 | 79 |
| 549 | 739572 | 739651 | 739730 | 739810 | 739889 | 739968 | 740047 | 740126 | 740205 | 740284 | 79 |
| 550 | 740363 | 740442 | 740521 | 740599 | 740678 | 740757 | 740836 | 740915 | 740994 | 741073 | 79 |
| 551 | 741152 | 741230 | 741309 | 741388 | 741467 | 741546 | 741624 | 741703 | 741782 | 741860 | 79 |
| 552 | 741939 | 742018 | 742096 | 742175 | 742254 | 742332 | 742411 | 742489 | 742568 | 742647 | 79 |
| 553 | 742725 | 742804 | 742882 | 742961 | 743039 | 743118 | 743196 | 743275 | 743353 | 743431 | 78 |
| 554 | 743510 | 743588 | 743667 | 743745 | 743823 | 743902 | 743980 | 744058 | 744136 | 744215 | 78 |
| 555 | 744293 | 744371 | 744449 | 744528 | 744606 | 744684 | 744762 | 744840 | 744919 | 744997 | 78 |
| 556 | 745075 | 745153 | 745231 | 745309 | 745387 | 745465 | 745543 | 745621 | 745699 | 745777 | 78 |
| 557 | 745855 | 745933 | 746011 | 746089 | 746167 | 746245 | 746323 | 746401 | 746479 | 746556 | 78 |
| 558 | 746634 | 746712 | 746790 | 746868 | 746945 | 747023 | 747101 | 747179 | 747256 | 747334 | 78 |
| 559 | 747412 | 747489 | 747567 | 747645 | 747722 | 747800 | 747878 | 747955 | 748033 | 748110 | 78 |
| 560 | 748188 | 748266 | 748343 | 748421 | 748498 | 748576 | 748653 | 748731 | 748808 | 748885 | 77 |
| 561 | 748963 | 749040 | 749118 | 749195 | 749272 | 749350 | 749427 | 749504 | 749582 | 749659 | 77 |
| 562 | 749736 | 749814 | 749891 | 749968 | 750045 | 750123 | 750200 | 750277 | 750354 | 750431 | 77 |
| 563 | 750508 | 750586 | 750663 | 750740 | 750817 | 750894 | 750971 | 751048 | 751125 | 751202 | 77 |
| 564 | 751279 | 751356 | 751433 | 751510 | 751587 | 751664 | 751741 | 751818 | 751895 | 751972 | 77 |
| 565 | 752048 | 752125 | 752202 | 752279 | 752356 | 752433 | 752509 | 752586 | 752663 | 752740 | 77 |
| 566 | 752816 | 752893 | 752970 | 753047 | 753123 | 753200 | 753277 | 753353 | 753430 | 753506 | 77 |
| 567 | 753583 | 753660 | 753736 | 753813 | 753889 | 753966 | 754042 | 754119 | 754195 | 754272 | 77 |
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| 569 | 755112 | 755189 | 755265 | 755341 | 755417 | 755494 | 755570 | 755646 | 755722 | 755799 | 76 |
| 570 | 755875 | 755951 | 756027 | 756103 | 756180 | 756256 | 756332 | 756408 | 756484 | 756560 | 76 |
| 571 | 756636 | 756712 | 756788 | 756864 | 756940 | 757016 | 757092 | 757168 | 757244 | 757320 | 76 |
| 572 | 757396 | 757472 | 757548 | 757624 | 757700 | 757775 | 757851 | 757927 | 758003 | 758079 | 76 |
| 573 | 758155 | 758230 | 758306 | 758382 | 758458 | 758533 | 758609 | 758685 | 758761 | 758836 | 76 |
| 574 | 758912 | 758988 | 759063 | 759139 | 759214 | 759290 | 759366 | 759441 | 759517 | 759592 | 76 |
| 575 | 759668 | 759743 | 759819 | 759894 | 759970 | 760045 | 760121 | 760196 | 760272 | 760347 | 75 |
| 576 | 760422 | 760498 | 760573 | 760649 | 760724 | 760799 | 760875 | 760950 | 761025 | 761101 | 75 |
| 577 | 761176 | 761251 | 761326 | 761402 | 761477 | 761552 | 761627 | 761702 | 761778 | 761853 | 75 |
| 578 | 761928 | 762003 | 762078 | 762153 | 762228 | 762303 | 762378 | 762453 | 762529 | 762604 | 75 |
| 579 | 762679 | 762754 | 762829 | 762904 | 762978 | 763053 | 763128 | 763203 | 763278 | 763353 | 75 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

No. 5800———6400 Log. 763428———806180.

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| 581 | 764176 | 764251 | 764326 | 764400 | 764475 | 764550 | 764624 | 764699 | 764774 | 764848 | 75 |
| 582 | 764923 | 764998 | 765072 | 765147 | 765221 | 765296 | 765370 | 765445 | 765520 | 765594 | 75 |
| 583 | 765669 | 765743 | 765818 | 765892 | 765966 | 766041 | 766115 | 766190 | 766264 | 766338 | 74 |
| 584 | 766413 | 766487 | 766562 | 766636 | 766710 | 766785 | 766859 | 766933 | 767007 | 767082 | 74 |
| 585 | 767156 | 767230 | 767304 | 767379 | 767453 | 767527 | 767601 | 767675 | 767749 | 767823 | 74 |
| 586 | 767898 | 767972 | 768046 | 768120 | 768194 | 768268 | 768342 | 768416 | 768490 | 768561 | 74 |
| 587 | 768638 | 768712 | 768786 | 768860 | 768934 | 769008 | 769082 | 769156 | 769230 | 769303 | 74 |
| 588 | 769377 | 769451 | 769525 | 769599 | 769673 | 769746 | 769820 | 769894 | 769968 | 770042 | 74 |
| 589 | 770115 | 770189 | 770263 | 770336 | 770410 | 770484 | 770557 | 770631 | 770705 | 770778 | 74 |
| 590 | 770852 | 770926 | 770999 | 771073 | 771146 | 771220 | 771293 | 771367 | 771440 | 771514 | 74 |
| 591 | 771587 | 771661 | 771734 | 771808 | 771881 | 771955 | 772028 | 772102 | 772175 | 772248 | 73 |
| 592 | 772322 | 772395 | 772468 | 772542 | 772615 | 772688 | 772762 | 772835 | 772908 | 772981 | 73 |
| 593 | 773055 | 773128 | 773201 | 773274 | 773348 | 773421 | 773494 | 773567 | 773640 | 773713 | 73 |
| 594 | 773786 | 773860 | 773933 | 774006 | 774079 | 774152 | 774225 | 774298 | 774371 | 774444 | 73 |
| 595 | 774517 | 774590 | 774663 | 774736 | 774809 | 774882 | 774955 | 775028 | 775100 | 775173 | 73 |
| 596 | 775246 | 775319 | 775392 | 775465 | 775538 | 775610 | 775683 | 775756 | 775829 | 775902 | 73 |
| 597 | 775974 | 776047 | 776120 | 776193 | 776265 | 776338 | 776411 | 776483 | 776556 | 776629 | 73 |
| 598 | 776701 | 776774 | 776846 | 776919 | 776992 | 777064 | 777137 | 777209 | 777282 | 777354 | 73 |
| 599 | 777427 | 777499 | 777572 | 777644 | 777717 | 777789 | 777862 | 777934 | 778006 | 778079 | 73 |
| 600 | 778151 | 778224 | 778296 | 778368 | 778441 | 778513 | 778585 | 778658 | 778730 | 778802 | 72 |
| 601 | 778874 | 778947 | 779019 | 779091 | 779163 | 779236 | 779308 | 779380 | 779452 | 779524 | 72 |
| 602 | 779596 | 779669 | 779741 | 779813 | 779885 | 779957 | 780029 | 780101 | 780173 | 780245 | 72 |
| 603 | 780317 | 780389 | 780461 | 780533 | 780605 | 780677 | 780749 | 780821 | 780893 | 780965 | 72 |
| 604 | 781037 | 781109 | 781181 | 781253 | 781324 | 781396 | 781468 | 781540 | 781612 | 781684 | 72 |
| 605 | 781755 | 781827 | 781899 | 781971 | 782042 | 782114 | 782186 | 782258 | 782329 | 782401 | 72 |
| 606 | 782473 | 782544 | 782616 | 782688 | 782759 | 782831 | 782902 | 782974 | 783046 | 783117 | 72 |
| 607 | 783189 | 783260 | 783332 | 783403 | 783475 | 783546 | 783618 | 783689 | 783761 | 783832 | 71 |
| 608 | 783904 | 783975 | 784046 | 784118 | 784189 | 784261 | 784332 | 784403 | 784475 | 784546 | 71 |
| 609 | 784617 | 784689 | 784760 | 784831 | 784902 | 784974 | 785045 | 785116 | 785187 | 785259 | 71 |
| 610 | 785330 | 785401 | 785472 | 785543 | 785615 | 785686 | 785757 | 785828 | 785899 | 785970 | 71 |
| 611 | 786041 | 786112 | 786183 | 786254 | 786325 | 786396 | 786467 | 786538 | 786609 | 786680 | 71 |
| 612 | 786751 | 786822 | 786893 | 786964 | 787035 | 787106 | 787177 | 787248 | 787319 | 787390 | 71 |
| 613 | 787460 | 787531 | 787602 | 787673 | 787744 | 787815 | 787885 | 787956 | 788027 | 788098 | 71 |
| 614 | 788168 | 788239 | 788310 | 788381 | 788451 | 788522 | 788593 | 788663 | 788734 | 788804 | 71 |
| 615 | 788875 | 788946 | 789016 | 789087 | 789157 | 789228 | 789299 | 789369 | 789440 | 789510 | 71 |
| 616 | 789581 | 789651 | 789722 | 789792 | 789863 | 789933 | 790004 | 790074 | 790144 | 790215 | 70 |
| 617 | 790285 | 790356 | 790426 | 790496 | 790567 | 790637 | 790707 | 790778 | 790848 | 790918 | 70 |
| 618 | 790988 | 791059 | 791129 | 791199 | 791269 | 791340 | 791410 | 791480 | 791550 | 791620 | 70 |
| 619 | 791691 | 791761 | 791831 | 791901 | 791971 | 792041 | 792111 | 792181 | 792252 | 792322 | 70 |
| 620 | 792392 | 792462 | 792532 | 792602 | 792672 | 792742 | 792812 | 792882 | 792952 | 793022 | 70 |
| 621 | 793092 | 793162 | 793231 | 793301 | 793371 | 793441 | 793511 | 793581 | 793651 | 793721 | 70 |
| 622 | 793790 | 793860 | 793930 | 794000 | 794070 | 794139 | 794209 | 794279 | 794349 | 794418 | 70 |
| 623 | 794488 | 794558 | 794627 | 794697 | 794767 | 794836 | 794906 | 794976 | 795045 | 795115 | 70 |
| 624 | 795185 | 795254 | 795324 | 795393 | 795463 | 795532 | 795602 | 795671 | 795741 | 795811 | 69 |
| 625 | 795880 | 795949 | 796019 | 796088 | 796158 | 796227 | 796297 | 796366 | 796436 | 796505 | 69 |
| 626 | 796574 | 796644 | 796713 | 796782 | 796852 | 796921 | 796990 | 797060 | 797129 | 797198 | 69 |
| 627 | 797268 | 797337 | 797406 | 797475 | 797545 | 797614 | 797683 | 797752 | 797821 | 797890 | 69 |
| 628 | 797960 | 798029 | 798098 | 798167 | 798236 | 798305 | 798374 | 798443 | 798512 | 798582 | 69 |
| 629 | 798651 | 798720 | 798789 | 798858 | 798927 | 798996 | 799065 | 799134 | 799203 | 799272 | 69 |
| 630 | 799341 | 799409 | 799478 | 799547 | 799616 | 799685 | 799754 | 799823 | 799892 | 799961 | 69 |
| 631 | 800029 | 800098 | 800167 | 800236 | 800305 | 800373 | 800442 | 800511 | 800580 | 800648 | 69 |
| 632 | 800717 | 800786 | 800854 | 800923 | 800992 | 801060 | 801129 | 801198 | 801266 | 801335 | 69 |
| 633 | 801404 | 801472 | 801541 | 801609 | 801678 | 801747 | 801815 | 801884 | 801952 | 802021 | 69 |
| 634 | 802089 | 802158 | 802226 | 802295 | 802363 | 802432 | 802500 | 802568 | 802637 | 802705 | 68 |
| 635 | 802774 | 802842 | 802910 | 802979 | 803047 | 803116 | 803184 | 803252 | 803321 | 803389 | 68 |
| 636 | 803457 | 803525 | 803594 | 803662 | 803730 | 803798 | 803867 | 803935 | 804003 | 804071 | 68 |
| 637 | 804139 | 804208 | 804276 | 804344 | 804412 | 804480 | 804548 | 804616 | 804685 | 804753 | 68 |
| 638 | 804821 | 804889 | 804957 | 805025 | 805093 | 805161 | 805229 | 805297 | 805365 | 805433 | 68 |
| 639 | 805501 | 805569 | 805637 | 805705 | 805773 | 805841 | 805908 | 805976 | 806044 | 806112 | 68 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 6400——7000 Log. 806180——845098

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| 641 | 806858 | 806926 | 806994 | 807061 | 807129 | 807197 | 807264 | 807332 | 807400 | 807467 | 68 |
| 642 | 807535 | 807603 | 807670 | 807738 | 807806 | 807873 | 807941 | 808008 | 808076 | 808143 | 68 |
| 643 | 808211 | 808279 | 808346 | 808414 | 808481 | 808549 | 808616 | 808684 | 808751 | 808818 | 68 |
| 644 | 808886 | 808953 | 809021 | 809088 | 809156 | 809223 | 809290 | 809358 | 809425 | 809492 | 67 |
| 645 | 809560 | 809627 | 809694 | 809762 | 809829 | 809896 | 809964 | 810031 | 810098 | 810165 | 67 |
| 646 | 810233 | 810300 | 810367 | 810434 | 810501 | 810569 | 810636 | 810703 | 810770 | 810837 | 67 |
| 647 | 810904 | 810971 | 811038 | 811106 | 811173 | 811240 | 811307 | 811374 | 811441 | 811508 | 67 |
| 648 | 811575 | 811642 | 811709 | 811776 | 811843 | 811910 | 811977 | 812044 | 812111 | 812178 | 67 |
| 649 | 812245 | 812312 | 812378 | 812445 | 812512 | 812579 | 812646 | 812713 | 812780 | 812847 | 67 |
| 650 | 812913 | 812980 | 813047 | 813114 | 813181 | 813247 | 813314 | 813381 | 813448 | 813514 | 67 |
| 651 | 813581 | 813648 | 813714 | 813781 | 813848 | 813914 | 813981 | 814048 | 814114 | 814181 | 67 |
| 652 | 814248 | 814314 | 814381 | 814447 | 814514 | 814581 | 814647 | 814714 | 814780 | 814847 | 67 |
| 653 | 814913 | 814980 | 815046 | 815113 | 815179 | 815246 | 815312 | 815378 | 815445 | 815511 | 66 |
| 654 | 815578 | 815644 | 815711 | 815777 | 815843 | 815910 | 815976 | 816042 | 816109 | 816175 | 66 |
| 655 | 816241 | 816308 | 816374 | 816440 | 816506 | 816573 | 816639 | 816705 | 816771 | 816838 | 66 |
| 656 | 816904 | 816970 | 817036 | 817102 | 817169 | 817235 | 817301 | 817367 | 817433 | 817499 | 66 |
| 657 | 817565 | 817631 | 817698 | 817764 | 817830 | 817896 | 817962 | 818028 | 818094 | 818160 | 66 |
| 658 | 818226 | 818292 | 818358 | 818424 | 818490 | 818556 | 818622 | 818688 | 818754 | 818819 | 66 |
| 659 | 818885 | 818951 | 819017 | 819083 | 819149 | 819215 | 819281 | 819346 | 819412 | 819478 | 66 |
| 660 | 819544 | 819610 | 819675 | 819741 | 819807 | 819873 | 819939 | 820004 | 820070 | 820136 | 66 |
| 661 | 820201 | 820267 | 820333 | 820399 | 820464 | 820530 | 820595 | 820661 | 820727 | 820792 | 66 |
| 662 | 820858 | 820924 | 820989 | 821055 | 821120 | 821186 | 821251 | 821317 | 821382 | 821448 | 66 |
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| 664 | 822168 | 822233 | 822299 | 822364 | 822430 | 822495 | 822560 | 822626 | 822691 | 822756 | 65 |
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| 666 | 823474 | 823539 | 823605 | 823670 | 823735 | 823800 | 823865 | 823930 | 823996 | 824061 | 65 |
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| 679 | 831870 | 831934 | 831998 | 832062 | 832126 | 832189 | 832253 | 832317 | 832381 | 832445 | 64 |
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| 685 | 835691 | 835754 | 835817 | 835881 | 835944 | 836007 | 836071 | 836134 | 836197 | 836261 | 63 |
| 686 | 836324 | 836387 | 836451 | 836514 | 836577 | 836641 | 836704 | 836767 | 836830 | 836894 | 63 |
| 687 | 836957 | 837020 | 837083 | 837146 | 837210 | 837273 | 837336 | 837399 | 837462 | 837525 | 63 |
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| 689 | 838219 | 838282 | 838345 | 838408 | 838471 | 838534 | 838597 | 838660 | 838723 | 838786 | 63 |
| 690 | 838849 | 838912 | 838975 | 839038 | 839101 | 839164 | 839227 | 839289 | 839352 | 839415 | 63 |
| 691 | 839478 | 839541 | 839604 | 839667 | 839729 | 839792 | 839855 | 839918 | 839981 | 840043 | 63 |
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| 693 | 840733 | 840796 | 840859 | 840921 | 840984 | 841046 | 841109 | 841172 | 841234 | 841297 | 63 |
| 694 | 841359 | 841422 | 841485 | 841547 | 841610 | 841672 | 841735 | 841797 | 841860 | 841922 | 63 |
| 695 | 841985 | 842047 | 842110 | 842172 | 842235 | 842297 | 842360 | 842422 | 842484 | 842547 | 62 |
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| 697 | 843233 | 843295 | 843357 | 843420 | 843482 | 843544 | 843606 | 843669 | 843731 | 843793 | 62 |
| 698 | 843855 | 843918 | 843980 | 844042 | 844104 | 844166 | 844229 | 844291 | 844353 | 844415 | 62 |
| 699 | 844477 | 844539 | 844601 | 844664 | 844726 | 844788 | 844850 | 844912 | 844974 | 845036 | 62 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

No. 7000———7600 Log. 845098———880814

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 700 | 845098 | 845160 | 845222 | 845284 | 845346 | 845408 | 845470 | 845532 | 845594 | 845656 | 62 |
| 701 | 845718 | 845780 | 845842 | 845904 | 845966 | 846028 | 846090 | 846151 | 846213 | 846275 | 62 |
| 702 | 846337 | 846399 | 846461 | 846523 | 846584 | 846646 | 846708 | 846770 | 846832 | 846894 | 62 |
| 703 | 846955 | 847017 | 847079 | 847141 | 847202 | 847264 | 847326 | 847388 | 847449 | 847511 | 62 |
| 704 | 847573 | 847634 | 847696 | 847758 | 847819 | 847881 | 847943 | 848004 | 848066 | 848127 | 62 |
| 705 | 848189 | 848251 | 848312 | 848374 | 848435 | 848497 | 848559 | 848620 | 848682 | 848743 | 62 |
| 706 | 848805 | 848866 | 848928 | 848989 | 849051 | 849112 | 849174 | 849235 | 849296 | 849358 | 61 |
| 707 | 849419 | 849481 | 849542 | 849604 | 849665 | 849726 | 849788 | 849849 | 849911 | 849972 | 61 |
| 708 | 850033 | 850095 | 850156 | 850217 | 850279 | 850340 | 850401 | 850462 | 850524 | 850585 | 61 |
| 709 | 850646 | 850707 | 850769 | 850830 | 850891 | 850952 | 851014 | 851075 | 851136 | 851197 | 61 |
| 710 | 851258 | 851320 | 851381 | 851442 | 851503 | 851564 | 851625 | 851686 | 851747 | 851808 | 61 |
| 711 | 851870 | 851931 | 851992 | 852053 | 852114 | 852175 | 852236 | 852297 | 852358 | 852419 | 61 |
| 712 | 852480 | 852541 | 852602 | 852663 | 852724 | 852785 | 852846 | 852907 | 852968 | 853029 | 61 |
| 713 | 853090 | 853150 | 853211 | 853272 | 853333 | 853394 | 853455 | 853516 | 853576 | 853637 | 61 |
| 714 | 853698 | 853759 | 853820 | 853881 | 853941 | 854002 | 854063 | 854124 | 854185 | 854245 | 61 |
| 715 | 854306 | 854367 | 854427 | 854488 | 854549 | 854610 | 854670 | 854731 | 854792 | 854852 | 61 |
| 716 | 854913 | 854974 | 855034 | 855095 | 855156 | 855216 | 855277 | 855337 | 855398 | 855459 | 61 |
| 717 | 855519 | 855580 | 855640 | 855701 | 855761 | 855822 | 855882 | 855943 | 856003 | 856064 | 61 |
| 718 | 856124 | 856185 | 856245 | 856306 | 856366 | 856427 | 856487 | 856548 | 856608 | 856668 | 60 |
| 719 | 856729 | 856789 | 856850 | 856910 | 856970 | 857031 | 857091 | 857151 | 857212 | 857272 | 60 |
| 720 | 857332 | 857393 | 857453 | 857513 | 857574 | 857634 | 857694 | 857754 | 857815 | 857875 | 60 |
| 721 | 857935 | 857995 | 858056 | 858116 | 858176 | 858236 | 858297 | 858357 | 858417 | 858477 | 60 |
| 722 | 858537 | 858597 | 858657 | 858718 | 858778 | 858838 | 858898 | 858958 | 859018 | 859078 | 60 |
| 723 | 859138 | 859198 | 859258 | 859318 | 859378 | 859438 | 859499 | 859559 | 859619 | 859679 | 60 |
| 724 | 859739 | 859799 | 859858 | 859918 | 859978 | 860038 | 860098 | 860158 | 860218 | 860278 | 60 |
| 725 | 860338 | 860398 | 860458 | 860518 | 860578 | 860637 | 860697 | 860757 | 860817 | 860877 | 60 |
| 726 | 860937 | 860996 | 861056 | 861116 | 861176 | 861236 | 861295 | 861355 | 861415 | 861475 | 60 |
| 727 | 861534 | 861594 | 861654 | 861714 | 861773 | 861833 | 861893 | 861952 | 862012 | 862072 | 60 |
| 728 | 862131 | 862191 | 862251 | 862310 | 862370 | 862430 | 862489 | 862549 | 862608 | 862668 | 60 |
| 729 | 862728 | 862787 | 862847 | 862906 | 862966 | 863025 | 863085 | 863144 | 863204 | 863263 | 60 |
| 730 | 863323 | 863382 | 863442 | 863501 | 863561 | 863620 | 863680 | 863739 | 863798 | 863858 | 59 |
| 731 | 863917 | 863977 | 864036 | 864096 | 864155 | 864214 | 864274 | 864333 | 864392 | 864452 | 59 |
| 732 | 864511 | 864570 | 864630 | 864689 | 864748 | 864808 | 864867 | 864926 | 864985 | 865045 | 59 |
| 733 | 865104 | 865163 | 865222 | 865282 | 865341 | 865400 | 865459 | 865518 | 865578 | 865637 | 59 |
| 734 | 865696 | 865755 | 865814 | 865874 | 865933 | 865992 | 866051 | 866110 | 866169 | 866228 | 59 |
| 735 | 866287 | 866346 | 866405 | 866465 | 866524 | 866583 | 866642 | 866701 | 866760 | 866819 | 59 |
| 736 | 866878 | 866937 | 866996 | 867055 | 867114 | 867173 | 867232 | 867291 | 867350 | 867409 | 59 |
| 737 | 867467 | 867526 | 867585 | 867644 | 867703 | 867762 | 867821 | 867880 | 867939 | 867998 | 59 |
| 738 | 868056 | 868115 | 868174 | 868233 | 868292 | 868350 | 868409 | 868468 | 868527 | 868586 | 59 |
| 739 | 868644 | 868703 | 868762 | 868821 | 868879 | 868938 | 868997 | 869056 | 869114 | 869173 | 59 |
| 740 | 869232 | 869290 | 869349 | 869408 | 869466 | 869525 | 869584 | 869642 | 869701 | 869760 | 59 |
| 741 | 869818 | 869877 | 869935 | 869994 | 870053 | 870111 | 870170 | 870228 | 870287 | 870345 | 59 |
| 742 | 870404 | 870462 | 870521 | 870579 | 870638 | 870696 | 870755 | 870813 | 870872 | 870930 | 58 |
| 743 | 870989 | 871047 | 871106 | 871164 | 871223 | 871281 | 871339 | 871398 | 871456 | 871515 | 58 |
| 744 | 871573 | 871631 | 871690 | 871748 | 871806 | 871865 | 871923 | 871981 | 872040 | 872098 | 58 |
| 745 | 872156 | 872215 | 872273 | 872331 | 872389 | 872448 | 872506 | 872564 | 872622 | 872681 | 58 |
| 746 | 872739 | 872797 | 872855 | 872913 | 872972 | 873030 | 873088 | 873146 | 873204 | 873262 | 58 |
| 747 | 873321 | 873379 | 873437 | 873495 | 873553 | 873611 | 873669 | 873727 | 873785 | 873844 | 58 |
| 748 | 873902 | 873960 | 874018 | 874076 | 874134 | 874192 | 874250 | 874308 | 874366 | 874424 | 58 |
| 749 | 874482 | 874540 | 874598 | 874656 | 874714 | 874772 | 874830 | 874887 | 874945 | 875003 | 58 |
| 750 | 875061 | 875119 | 875177 | 875235 | 875293 | 875351 | 875409 | 875466 | 875524 | 875582 | 58 |
| 751 | 875640 | 875698 | 875756 | 875813 | 875871 | 875929 | 875987 | 876045 | 876102 | 876160 | 58 |
| 752 | 876218 | 876276 | 876333 | 876391 | 876449 | 876507 | 876564 | 876622 | 876680 | 876737 | 58 |
| 753 | 876795 | 876853 | 876910 | 876968 | 877026 | 877083 | 877141 | 877198 | 877256 | 877314 | 58 |
| 754 | 877371 | 877429 | 877486 | 877544 | 877602 | 877659 | 877717 | 877774 | 877832 | 877889 | 58 |
| 755 | 877947 | 878004 | 878062 | 878119 | 878177 | 878234 | 878292 | 878349 | 878407 | 878464 | 57 |
| 756 | 878522 | 878579 | 878637 | 878694 | 878751 | 878809 | 878866 | 878924 | 878981 | 879038 | 57 |
| 757 | 879096 | 879153 | 879211 | 879268 | 879325 | 879383 | 879440 | 879497 | 879555 | 879612 | 57 |
| 758 | 879669 | 879726 | 879784 | 879841 | 879898 | 879956 | 880013 | 880070 | 880127 | 880185 | 57 |
| 759 | 880242 | 880299 | 880356 | 880413 | 880471 | 880528 | 880585 | 880642 | 880699 | 880756 | 57 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 7600——8200 Log. 880814——913814

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 760 | 880814 | 880871 | 880928 | 880985 | 881042 | 881099 | 881156 | 881213 | 881270 | 881328 | 57 |
| 761 | 881385 | 881442 | 881499 | 881556 | 881613 | 881670 | 881727 | 881784 | 881841 | 881898 | 57 |
| 762 | 881955 | 882012 | 882069 | 882126 | 882183 | 882240 | 882297 | 882354 | 882411 | 882468 | 57 |
| 763 | 882524 | 882581 | 882638 | 882695 | 882752 | 882809 | 882866 | 882923 | 882980 | 883037 | 57 |
| 764 | 883093 | 883150 | 883207 | 883264 | 883321 | 883377 | 883434 | 883491 | 883548 | 883605 | 57 |
| 765 | 883661 | 883718 | 883775 | 883832 | 883888 | 883945 | 884002 | 884059 | 884115 | 884172 | 57 |
| 766 | 884229 | 884285 | 884342 | 884399 | 884455 | 884512 | 884569 | 884625 | 884682 | 884739 | 57 |
| 767 | 884795 | 884852 | 884909 | 884965 | 885022 | 885078 | 885135 | 885192 | 885248 | 885305 | 57 |
| 768 | 885361 | 885418 | 885474 | 885531 | 885587 | 885644 | 885700 | 885757 | 885813 | 885870 | 57 |
| 769 | 885926 | 885983 | 886039 | 886096 | 886152 | 886209 | 886265 | 886321 | 886378 | 886434 | 56 |
| 770 | 886491 | 886547 | 886604 | 886660 | 886716 | 886773 | 886829 | 886885 | 886942 | 886998 | 56 |
| 771 | 887054 | 887111 | 887167 | 887223 | 887280 | 887336 | 887392 | 887449 | 887505 | 887561 | 56 |
| 772 | 887617 | 887674 | 887730 | 887786 | 887842 | 887898 | 887955 | 888011 | 888067 | 888123 | 56 |
| 773 | 888179 | 888236 | 888292 | 888348 | 888404 | 888460 | 888516 | 888573 | 888629 | 888685 | 56 |
| 774 | 888741 | 888797 | 888853 | 888909 | 888965 | 889021 | 889077 | 889134 | 889190 | 889246 | 56 |
| 775 | 889302 | 889358 | 889414 | 889470 | 889526 | 889582 | 889638 | 889694 | 889750 | 889806 | 56 |
| 776 | 889862 | 889918 | 889974 | 890030 | 890086 | 890141 | 890197 | 890253 | 890309 | 890365 | 56 |
| 777 | 890421 | 890477 | 890533 | 890589 | 890644 | 890700 | 890756 | 890812 | 890868 | 890924 | 56 |
| 778 | 890980 | 891035 | 891091 | 891147 | 891203 | 891259 | 891314 | 891370 | 891426 | 891482 | 56 |
| 779 | 891537 | 891593 | 891649 | 891705 | 891760 | 891816 | 891872 | 891928 | 891983 | 892039 | 56 |
| 780 | 892095 | 892150 | 892206 | 892262 | 892317 | 892373 | 892429 | 892484 | 892540 | 892595 | 56 |
| 781 | 892651 | 892707 | 892762 | 892818 | 892873 | 892929 | 892985 | 893040 | 893096 | 893151 | 56 |
| 782 | 893207 | 893262 | 893318 | 893373 | 893429 | 893484 | 893540 | 893595 | 893651 | 893706 | 56 |
| 783 | 893762 | 893817 | 893873 | 893928 | 893984 | 894040 | 894094 | 894150 | 894205 | 894261 | 56 |
| 784 | 894316 | 894371 | 894427 | 894482 | 894538 | 894593 | 894648 | 894704 | 894759 | 894814 | 55 |
| 785 | 894870 | 894925 | 894980 | 895036 | 895091 | 895146 | 895201 | 895257 | 895312 | 895367 | 55 |
| 786 | 895423 | 895478 | 895533 | 895588 | 895643 | 895699 | 895754 | 895809 | 895864 | 895920 | 55 |
| 787 | 895975 | 896030 | 896085 | 896140 | 896195 | 896251 | 896306 | 896361 | 896416 | 896471 | 55 |
| 788 | 896526 | 896581 | 896636 | 896692 | 896747 | 896802 | 896857 | 896912 | 896967 | 897022 | 55 |
| 789 | 897077 | 897132 | 897187 | 897242 | 897297 | 897352 | 897407 | 897462 | 897517 | 897572 | 55 |
| 790 | 897627 | 897682 | 897737 | 897792 | 897847 | 897902 | 897957 | 898012 | 898067 | 898122 | 55 |
| 791 | 898176 | 898231 | 898286 | 898341 | 898396 | 898451 | 898506 | 898561 | 898615 | 898670 | 55 |
| 792 | 898725 | 898780 | 898835 | 898890 | 898944 | 898999 | 899054 | 899109 | 899164 | 899218 | 55 |
| 793 | 899273 | 899328 | 899383 | 899437 | 899492 | 899547 | 899602 | 899656 | 899711 | 899766 | 55 |
| 794 | 899820 | 899875 | 899930 | 899985 | 900039 | 900094 | 900149 | 900203 | 900258 | 900312 | 55 |
| 795 | 900367 | 900422 | 900476 | 900531 | 900586 | 900640 | 900695 | 900749 | 900804 | 900858 | 55 |
| 796 | 900913 | 900968 | 901022 | 901077 | 901131 | 901186 | 901240 | 901295 | 901349 | 901404 | 55 |
| 797 | 901458 | 901513 | 901567 | 901622 | 901676 | 901731 | 901785 | 901840 | 901894 | 901948 | 54 |
| 798 | 902003 | 902057 | 902112 | 902166 | 902221 | 902275 | 902329 | 902384 | 902438 | 902491 | 54 |
| 799 | 902547 | 902601 | 902655 | 902710 | 902764 | 902818 | 902873 | 902927 | 902981 | 903036 | 54 |
| 800 | 903090 | 903144 | 903198 | 903253 | 903307 | 903361 | 903416 | 903470 | 903524 | 903578 | 54 |
| 801 | 903632 | 903687 | 903741 | 903795 | 903849 | 903903 | 903958 | 904012 | 904066 | 904120 | 54 |
| 802 | 904174 | 904228 | 904283 | 904337 | 904391 | 904445 | 904499 | 904553 | 904607 | 904661 | 54 |
| 803 | 904715 | 904770 | 904824 | 904878 | 904932 | 904986 | 905040 | 905094 | 905148 | 905202 | 54 |
| 804 | 905256 | 905310 | 905364 | 905418 | 905472 | 905526 | 905580 | 905634 | 905688 | 905742 | 54 |
| 805 | 905796 | 905850 | 905904 | 905958 | 906012 | 906065 | 906119 | 906173 | 906227 | 906281 | 54 |
| 806 | 906335 | 906389 | 906443 | 906497 | 906550 | 906604 | 906658 | 906712 | 906766 | 906820 | 54 |
| 807 | 906873 | 906927 | 906981 | 907035 | 907089 | 907142 | 907196 | 907250 | 907304 | 907358 | 54 |
| 808 | 907411 | 907465 | 907519 | 907573 | 907626 | 907680 | 907734 | 907787 | 907841 | 907895 | 54 |
| 809 | 907948 | 908002 | 908056 | 908109 | 908163 | 908217 | 908270 | 908324 | 908378 | 908431 | 54 |
| 810 | 908485 | 908539 | 908592 | 908646 | 908699 | 908753 | 908807 | 908860 | 908914 | 908967 | 54 |
| 811 | 909021 | 909074 | 909128 | 909181 | 909235 | 909288 | 909342 | 909395 | 909449 | 909502 | 54 |
| 812 | 909556 | 909609 | 909663 | 909716 | 909770 | 909823 | 909877 | 909930 | 909984 | 910037 | 53 |
| 813 | 910090 | 910144 | 910197 | 910251 | 910304 | 910358 | 910411 | 910464 | 910518 | 910571 | 53 |
| 814 | 910624 | 910678 | 910731 | 910784 | 910838 | 910891 | 910944 | 910998 | 911051 | 911104 | 53 |
| 815 | 911158 | 911211 | 911264 | 911317 | 911371 | 911424 | 911477 | 911530 | 911584 | 911637 | 53 |
| 816 | 911690 | 911743 | 911797 | 911850 | 911903 | 911956 | 912009 | 912063 | 912116 | 912169 | 53 |
| 817 | 912222 | 912275 | 912328 | 912381 | 912435 | 912488 | 912541 | 912594 | 912647 | 912700 | 53 |
| 818 | 912753 | 912806 | 912859 | 912913 | 912966 | 913019 | 913072 | 913125 | 913178 | 913231 | 53 |
| 819 | 913284 | 913337 | 913390 | 913443 | 913496 | 913549 | 913602 | 913655 | 913708 | 913761 | 53 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 8200——8800 Log. 913814——944483

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 820 | 913814 | 913867 | 913920 | 913973 | 914026 | 914079 | 914131 | 914184 | 914237 | 914290 | 53 |
| 821 | 914343 | 914396 | 914449 | 914502 | 914555 | 914608 | 914660 | 914713 | 914766 | 914819 | 53 |
| 822 | 914872 | 914925 | 914977 | 915030 | 915083 | 915136 | 915189 | 915241 | 915294 | 915347 | 53 |
| 823 | 915400 | 915453 | 915505 | 915558 | 915611 | 915664 | 915716 | 915769 | 915822 | 915874 | 53 |
| 824 | 915927 | 915980 | 916033 | 916085 | 916138 | 916191 | 916243 | 916296 | 916349 | 916401 | 53 |
| 825 | 916454 | 916507 | 916559 | 916612 | 916664 | 916717 | 916770 | 916822 | 916875 | 916927 | 53 |
| 826 | 916980 | 917033 | 917085 | 917138 | 917190 | 917243 | 917295 | 917348 | 917400 | 917453 | 53 |
| 827 | 917505 | 917558 | 917610 | 917663 | 917715 | 917768 | 917820 | 917873 | 917925 | 917978 | 52 |
| 828 | 918030 | 918083 | 918135 | 918188 | 918240 | 918292 | 918345 | 918397 | 918450 | 918502 | 52 |
| 829 | 918555 | 918607 | 918659 | 918712 | 918764 | 918816 | 918869 | 918921 | 918973 | 919026 | 52 |
| 830 | 919078 | 919130 | 919183 | 919235 | 919287 | 919340 | 919392 | 919444 | 919496 | 919549 | 52 |
| 831 | 919601 | 919653 | 919705 | 919758 | 919810 | 919862 | 919914 | 919967 | 920019 | 920071 | 52 |
| 832 | 920123 | 920175 | 920228 | 920280 | 920332 | 920384 | 920436 | 920489 | 920541 | 920593 | 52 |
| 833 | 920645 | 920697 | 920749 | 920801 | 920853 | 920906 | 920958 | 921010 | 921062 | 921114 | 52 |
| 834 | 921166 | 921218 | 921270 | 921322 | 921374 | 921426 | 921478 | 921530 | 921582 | 921634 | 52 |
| 835 | 921686 | 921738 | 921790 | 921842 | 921894 | 921946 | 921998 | 922050 | 922102 | 922154 | 52 |
| 836 | 922206 | 922258 | 922310 | 922362 | 922414 | 922466 | 922518 | 922570 | 922622 | 922674 | 52 |
| 837 | 922725 | 922777 | 922829 | 922881 | 922933 | 922985 | 923037 | 923088 | 923140 | 923192 | 52 |
| 838 | 923244 | 923296 | 923348 | 923399 | 923451 | 923503 | 923555 | 923607 | 923658 | 923710 | 52 |
| 839 | 923762 | 923814 | 923865 | 923917 | 923969 | 924021 | 924072 | 924124 | 924176 | 924228 | 52 |
| 840 | 924279 | 924331 | 924383 | 924434 | 924486 | 924538 | 924589 | 924641 | 924693 | 924744 | 52 |
| 841 | 924796 | 924848 | 924899 | 924951 | 925002 | 925054 | 925106 | 925157 | 925209 | 925260 | 52 |
| 842 | 925312 | 925364 | 925415 | 925467 | 925518 | 925570 | 925621 | 925673 | 925724 | 925776 | 52 |
| 843 | 925828 | 925879 | 925931 | 925982 | 926034 | 926085 | 926137 | 926188 | 926239 | 926291 | 51 |
| 844 | 926342 | 926394 | 926445 | 926497 | 926548 | 926600 | 926651 | 926702 | 926754 | 926805 | 51 |
| 845 | 926857 | 926908 | 926959 | 927011 | 927062 | 927114 | 927165 | 927216 | 927268 | 927319 | 51 |
| 846 | 927370 | 927422 | 927473 | 927524 | 927576 | 927627 | 927678 | 927730 | 927781 | 927832 | 51 |
| 847 | 927883 | 927935 | 927986 | 928037 | 928088 | 928140 | 928191 | 928242 | 928293 | 928345 | 51 |
| 848 | 928396 | 928447 | 928498 | 928549 | 928601 | 928652 | 928703 | 928754 | 928805 | 928856 | 51 |
| 849 | 928908 | 928959 | 929010 | 929061 | 929112 | 929163 | 929214 | 929266 | 929317 | 929368 | 51 |
| 850 | 929419 | 929470 | 929521 | 929572 | 929623 | 929674 | 929725 | 929776 | 929827 | 929878 | 51 |
| 851 | 929930 | 929981 | 930032 | 930083 | 930134 | 930185 | 930236 | 930287 | 930338 | 930389 | 51 |
| 852 | 930440 | 930491 | 930541 | 930592 | 930643 | 930694 | 930745 | 930796 | 930847 | 930898 | 51 |
| 853 | 930949 | 931000 | 931051 | 931102 | 931153 | 931203 | 931254 | 931305 | 931356 | 931407 | 51 |
| 854 | 931458 | 931509 | 931560 | 931610 | 931661 | 931712 | 931763 | 931814 | 931864 | 931915 | 51 |
| 855 | 931966 | 932017 | 932068 | 932118 | 932169 | 932220 | 932271 | 932321 | 932372 | 932423 | 51 |
| 856 | 932474 | 932524 | 932575 | 932626 | 932677 | 932727 | 932778 | 932829 | 932879 | 932930 | 51 |
| 857 | 932981 | 933031 | 933082 | 933133 | 933183 | 933234 | 933285 | 933335 | 933386 | 933437 | 51 |
| 858 | 933487 | 933538 | 933588 | 933639 | 933690 | 933740 | 933791 | 933841 | 933892 | 933943 | 51 |
| 859 | 933993 | 934044 | 934094 | 934145 | 934195 | 934246 | 934296 | 934347 | 934397 | 934448 | 51 |
| 860 | 934498 | 934549 | 934599 | 934650 | 934700 | 934751 | 934801 | 934852 | 934902 | 934953 | 50 |
| 861 | 935003 | 935054 | 935104 | 935154 | 935205 | 935255 | 935306 | 935356 | 935406 | 935457 | 50 |
| 862 | 935507 | 935558 | 935608 | 935658 | 935709 | 935759 | 935809 | 935860 | 935910 | 935960 | 50 |
| 863 | 936011 | 936061 | 936111 | 936162 | 936212 | 936262 | 936313 | 936363 | 936413 | 936463 | 50 |
| 864 | 936514 | 936564 | 936614 | 936664 | 936715 | 936765 | 936815 | 936865 | 936916 | 936966 | 50 |
| 865 | 937016 | 937066 | 937116 | 937167 | 937217 | 937267 | 937317 | 937367 | 937418 | 937468 | 50 |
| 866 | 937518 | 937568 | 937618 | 937668 | 937718 | 937769 | 937819 | 937869 | 937919 | 937969 | 50 |
| 867 | 938019 | 938069 | 938119 | 938169 | 938219 | 938269 | 938319 | 938370 | 938420 | 938470 | 50 |
| 868 | 938520 | 938570 | 938620 | 938670 | 938720 | 938770 | 938820 | 938870 | 938920 | 938970 | 50 |
| 869 | 939020 | 939070 | 939120 | 939170 | 939220 | 939270 | 939319 | 939369 | 939419 | 939469 | 50 |
| 870 | 939519 | 939569 | 939619 | 939669 | 939719 | 939769 | 939819 | 939868 | 939918 | 939968 | 50 |
| 871 | 940018 | 940068 | 940118 | 940168 | 940218 | 940267 | 940317 | 940367 | 940417 | 940467 | 50 |
| 872 | 940516 | 940566 | 940616 | 940666 | 940716 | 940765 | 940815 | 940865 | 940915 | 940964 | 50 |
| 873 | 941014 | 941064 | 941114 | 941163 | 941213 | 941263 | 941313 | 941362 | 941412 | 941462 | 50 |
| 874 | 941511 | 941561 | 941611 | 941660 | 941710 | 941760 | 941809 | 941859 | 941909 | 941958 | 50 |
| 875 | 942008 | 942058 | 942107 | 942157 | 942206 | 942256 | 942306 | 942355 | 942405 | 942454 | 50 |
| 876 | 942504 | 942554 | 942603 | 942653 | 942702 | 942752 | 942801 | 942851 | 942900 | 942950 | 50 |
| 877 | 943000 | 943049 | 943099 | 943148 | 943198 | 943247 | 943297 | 943346 | 943396 | 943445 | 49 |
| 878 | 943494 | 943544 | 943593 | 943643 | 943692 | 943742 | 943791 | 943841 | 943890 | 943939 | 49 |
| 879 | 943989 | 944038 | 944088 | 944137 | 944186 | 944236 | 944285 | 944335 | 944384 | 944133 | 49 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

# TABLE XXIV.

## LOGARITHMS OF NUMBERS.

No. 8800———9400 Log. 944483———973128.

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 880 | 944483 | 944532 | 944581 | 944631 | 944680 | 944729 | 944779 | 944828 | 944877 | 944927 | 49 |
| 881 | 944976 | 945025 | 945074 | 945124 | 945173 | 945222 | 945272 | 945321 | 945370 | 945419 | 49 |
| 882 | 945469 | 945518 | 945567 | 945616 | 945665 | 945715 | 945764 | 945813 | 945862 | 945911 | 49 |
| 883 | 945961 | 946010 | 946059 | 946108 | 946157 | 946207 | 946256 | 946305 | 946354 | 946403 | 49 |
| 884 | 946452 | 946501 | 946550 | 946600 | 946649 | 946698 | 946747 | 946796 | 946845 | 946894 | 49 |
| 885 | 946943 | 946992 | 947041 | 947090 | 947139 | 947189 | 947238 | 947287 | 947336 | 947385 | 49 |
| 886 | 947434 | 947483 | 947532 | 947581 | 947630 | 947679 | 947728 | 947777 | 947826 | 947875 | 49 |
| 887 | 947924 | 947973 | 948021 | 948070 | 948119 | 948168 | 948217 | 948266 | 948315 | 948364 | 49 |
| 888 | 948413 | 948462 | 948511 | 948560 | 948608 | 948657 | 948706 | 948755 | 948804 | 948853 | 49 |
| 889 | 948902 | 948951 | 948999 | 949048 | 949097 | 949146 | 949195 | 949244 | 949292 | 949341 | 49 |
| 890 | 949390 | 949439 | 949488 | 949536 | 949585 | 949634 | 949683 | 949731 | 949780 | 949829 | 49 |
| 891 | 949878 | 949926 | 949975 | 950024 | 950073 | 950121 | 950170 | 950219 | 950267 | 950316 | 49 |
| 892 | 950365 | 950413 | 950462 | 950511 | 950560 | 950608 | 950657 | 950705 | 950754 | 950803 | 49 |
| 893 | 950851 | 950900 | 950949 | 950997 | 951046 | 951095 | 951143 | 951192 | 951240 | 951289 | 49 |
| 894 | 951337 | 951386 | 951435 | 951483 | 951532 | 951580 | 951629 | 951677 | 951726 | 951774 | 49 |
| 895 | 951823 | 951872 | 951920 | 951969 | 952017 | 952066 | 952114 | 952163 | 952211 | 952259 | 48 |
| 896 | 952308 | 952356 | 952405 | 952453 | 952502 | 952550 | 952599 | 952647 | 952696 | 952744 | 48 |
| 897 | 952792 | 952841 | 952889 | 952938 | 952986 | 953034 | 953083 | 953131 | 953180 | 953228 | 48 |
| 898 | 953276 | 953325 | 953373 | 953421 | 953470 | 953518 | 953566 | 953615 | 953663 | 953711 | 48 |
| 899 | 953760 | 953808 | 953856 | 953905 | 953953 | 954001 | 954049 | 954098 | 954146 | 954194 | 48 |
| 900 | 954242 | 954291 | 954339 | 954387 | 954435 | 954484 | 954532 | 954580 | 954628 | 954677 | 48 |
| 901 | 954725 | 954773 | 954821 | 954869 | 954918 | 954966 | 955014 | 955062 | 955110 | 955158 | 48 |
| 902 | 955206 | 955255 | 955303 | 955351 | 955399 | 955447 | 955495 | 955543 | 955592 | 955640 | 48 |
| 903 | 955688 | 955736 | 955784 | 955832 | 955880 | 955928 | 955976 | 956024 | 956072 | 956120 | 48 |
| 904 | 956168 | 956216 | 956264 | 956312 | 956361 | 956409 | 956457 | 956505 | 956553 | 956601 | 48 |
| 905 | 956649 | 956697 | 956745 | 956792 | 956840 | 956888 | 956936 | 956984 | 957032 | 957080 | 48 |
| 906 | 957128 | 957176 | 957224 | 957272 | 957320 | 957368 | 957416 | 957464 | 957511 | 957559 | 48 |
| 907 | 957607 | 957655 | 957703 | 957751 | 957799 | 957847 | 957894 | 957942 | 957990 | 958038 | 48 |
| 908 | 958086 | 958134 | 958181 | 958229 | 958277 | 958325 | 958373 | 958420 | 958468 | 958516 | 48 |
| 909 | 958564 | 958612 | 958659 | 958707 | 958755 | 958803 | 958850 | 958898 | 958946 | 958994 | 48 |
| 910 | 959041 | 959089 | 959137 | 959184 | 959232 | 959280 | 959328 | 959375 | 959423 | 959471 | 48 |
| 911 | 959518 | 959566 | 959614 | 959661 | 959709 | 959757 | 959804 | 959852 | 959900 | 959947 | 48 |
| 912 | 959995 | 960042 | 960090 | 960138 | 960185 | 960233 | 960281 | 960328 | 960376 | 960423 | 48 |
| 913 | 960471 | 960518 | 960566 | 960613 | 960661 | 960709 | 960756 | 960804 | 960851 | 960899 | 48 |
| 914 | 960946 | 960994 | 961041 | 961089 | 961136 | 961184 | 961231 | 961279 | 961326 | 961374 | 48 |
| 915 | 961421 | 961469 | 961516 | 961563 | 961611 | 961658 | 961706 | 961753 | 961801 | 961848 | 47 |
| 916 | 961895 | 961943 | 961990 | 962038 | 962085 | 962132 | 962180 | 962227 | 962275 | 962322 | 47 |
| 917 | 962369 | 962417 | 962464 | 962511 | 962559 | 962606 | 962653 | 962701 | 962748 | 962795 | 47 |
| 918 | 962843 | 962890 | 962937 | 962985 | 963032 | 963079 | 963126 | 963174 | 963221 | 963268 | 47 |
| 919 | 963315 | 963363 | 963410 | 963457 | 963504 | 963552 | 963599 | 963646 | 963693 | 963741 | 47 |
| 920 | 963788 | 963835 | 963882 | 963929 | 963977 | 964024 | 964071 | 964118 | 964165 | 964212 | 47 |
| 921 | 964260 | 964307 | 964354 | 964401 | 964448 | 964495 | 964542 | 964590 | 964637 | 964684 | 47 |
| 922 | 964731 | 964778 | 964825 | 964872 | 964919 | 964966 | 965013 | 965060 | 965108 | 965155 | 47 |
| 923 | 965202 | 965249 | 965296 | 965343 | 965390 | 965437 | 965484 | 965531 | 965578 | 965625 | 47 |
| 924 | 965672 | 965719 | 965766 | 965813 | 965860 | 965907 | 965954 | 966001 | 966048 | 966095 | 47 |
| 925 | 966142 | 966189 | 966236 | 966283 | 966329 | 966376 | 966423 | 966470 | 966517 | 966564 | 47 |
| 926 | 966611 | 966658 | 966705 | 966752 | 966798 | 966845 | 966892 | 966939 | 966986 | 967033 | 47 |
| 927 | 967080 | 967127 | 967173 | 967220 | 967267 | 967314 | 967361 | 967408 | 967454 | 967501 | 47 |
| 928 | 967548 | 967595 | 967642 | 967688 | 967735 | 967782 | 967829 | 967875 | 967922 | 967969 | 47 |
| 929 | 968016 | 968062 | 968109 | 968156 | 968203 | 968249 | 968296 | 968343 | 968389 | 968436 | 47 |
| 930 | 968483 | 968530 | 968576 | 968623 | 968670 | 968716 | 968763 | 968810 | 968856 | 968903 | 47 |
| 931 | 968950 | 968996 | 969043 | 969090 | 969136 | 969183 | 969229 | 969276 | 969323 | 969369 | 47 |
| 932 | 969416 | 969462 | 969509 | 969556 | 969602 | 969649 | 969695 | 969742 | 969788 | 969835 | 47 |
| 933 | 969882 | 969928 | 969975 | 970021 | 970068 | 970114 | 970161 | 970207 | 970254 | 970300 | 47 |
| 934 | 970347 | 970393 | 970440 | 970486 | 970533 | 970579 | 970626 | 970672 | 970719 | 970765 | 47 |
| 935 | 970812 | 970858 | 970904 | 970951 | 970997 | 971044 | 971090 | 971137 | 971183 | 971229 | 46 |
| 936 | 971276 | 971322 | 971369 | 971415 | 971461 | 971508 | 971554 | 971600 | 971647 | 971693 | 46 |
| 937 | 971740 | 971786 | 971832 | 971879 | 971925 | 971971 | 972018 | 972064 | 972110 | 972156 | 46 |
| 938 | 972203 | 972249 | 972295 | 972342 | 972388 | 972434 | 972480 | 972527 | 972573 | 972619 | 46 |
| 939 | 972666 | 972712 | 972758 | 972804 | 972851 | 972897 | 972943 | 972989 | 973035 | 973082 | 46 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

No. 9400——10000 Log. 973128——000000

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 940 | 973128 | 973174 | 973220 | 973266 | 973313 | 973359 | 973405 | 973451 | 973497 | 973543 | 46 |
| 941 | 973590 | 973636 | 973682 | 973728 | 973774 | 973820 | 973866 | 973913 | 973959 | 974005 | 46 |
| 942 | 974051 | 974097 | 974143 | 974189 | 974235 | 974281 | 974327 | 974373 | 974420 | 974466 | 46 |
| 943 | 974512 | 974558 | 974604 | 974650 | 974696 | 974742 | 974788 | 974834 | 974880 | 974926 | 46 |
| 944 | 974972 | 975018 | 975064 | 975110 | 975156 | 975202 | 975248 | 975294 | 975340 | 975386 | 46 |
| 945 | 975432 | 975478 | 975524 | 975570 | 975616 | 975661 | 975707 | 975753 | 975799 | 975845 | 46 |
| 946 | 975891 | 975937 | 975983 | 976029 | 976075 | 976121 | 976166 | 976212 | 976258 | 976304 | 46 |
| 947 | 976350 | 976396 | 976442 | 976487 | 976533 | 976579 | 976625 | 976671 | 976717 | 976762 | 46 |
| 948 | 976808 | 976854 | 976900 | 976946 | 976991 | 977037 | 977083 | 977129 | 977175 | 977220 | 46 |
| 949 | 977266 | 977312 | 977358 | 977403 | 977449 | 977495 | 977541 | 977586 | 977632 | 977678 | 46 |
| 950 | 977724 | 977769 | 977815 | 977861 | 977906 | 977952 | 977998 | 978043 | 978089 | 978135 | 46 |
| 951 | 978180 | 978226 | 978272 | 978317 | 978363 | 978409 | 978454 | 978500 | 978546 | 978591 | 46 |
| 952 | 978637 | 978683 | 978728 | 978774 | 978819 | 978865 | 978911 | 978956 | 979002 | 979047 | 46 |
| 953 | 979093 | 979138 | 979184 | 979230 | 979275 | 979321 | 979366 | 979412 | 979457 | 979503 | 46 |
| 954 | 979548 | 979594 | 979639 | 979685 | 979730 | 979776 | 979821 | 979867 | 979912 | 979958 | 46 |
| 955 | 980003 | 980049 | 980094 | 980140 | 980185 | 980231 | 980276 | 980322 | 980367 | 980412 | 45 |
| 956 | 980458 | 980503 | 980549 | 980594 | 980640 | 980685 | 980730 | 980776 | 980821 | 980867 | 45 |
| 957 | 980912 | 980957 | 981003 | 981048 | 981093 | 981139 | 981184 | 981229 | 981275 | 981320 | 45 |
| 958 | 981365 | 981411 | 981456 | 981501 | 981547 | 981592 | 981637 | 981683 | 981728 | 981773 | 45 |
| 959 | 981819 | 981864 | 981909 | 981954 | 982000 | 982045 | 982090 | 982135 | 982181 | 982226 | 45 |
| 960 | 982271 | 982316 | 982362 | 982407 | 982452 | 982497 | 982543 | 982588 | 982633 | 982678 | 45 |
| 961 | 982723 | 982769 | 982814 | 982859 | 982904 | 982949 | 982994 | 983040 | 983085 | 983130 | 45 |
| 962 | 983175 | 983220 | 983265 | 983310 | 983356 | 983401 | 983446 | 983491 | 983536 | 983581 | 45 |
| 963 | 983626 | 983671 | 983716 | 983762 | 983807 | 983852 | 983897 | 983942 | 983987 | 984032 | 45 |
| 964 | 984077 | 984122 | 984167 | 984212 | 984257 | 984302 | 984347 | 984392 | 984437 | 984482 | 45 |
| 965 | 984527 | 984572 | 984617 | 984662 | 984707 | 984752 | 984797 | 984842 | 984887 | 984932 | 45 |
| 966 | 984977 | 985022 | 985067 | 985112 | 985157 | 985202 | 985247 | 985292 | 985337 | 985382 | 45 |
| 967 | 985426 | 985471 | 985516 | 985561 | 985606 | 985651 | 985696 | 985741 | 985786 | 985830 | 45 |
| 968 | 985875 | 985920 | 985965 | 986010 | 986055 | 986100 | 986144 | 986189 | 986234 | 986279 | 45 |
| 969 | 986324 | 986369 | 986413 | 986458 | 986503 | 986548 | 986593 | 986637 | 986682 | 986727 | 45 |
| 970 | 986772 | 986816 | 986861 | 986906 | 986951 | 986995 | 987040 | 987085 | 987130 | 987174 | 45 |
| 971 | 987219 | 987264 | 987309 | 987353 | 987398 | 987443 | 987487 | 987532 | 987577 | 987622 | 45 |
| 972 | 987666 | 987711 | 987756 | 987800 | 987845 | 987890 | 987934 | 987979 | 988024 | 988068 | 45 |
| 973 | 988113 | 988157 | 988202 | 988247 | 988291 | 988336 | 988381 | 988425 | 988470 | 988514 | 45 |
| 974 | 988559 | 988603 | 988648 | 988693 | 988737 | 988782 | 988826 | 988871 | 988915 | 988960 | 45 |
| 975 | 989005 | 989049 | 989094 | 989138 | 989183 | 989227 | 989272 | 989316 | 989361 | 989405 | 45 |
| 976 | 989450 | 989494 | 989539 | 989583 | 989628 | 989672 | 989717 | 989761 | 989806 | 989850 | 44 |
| 977 | 989895 | 989939 | 989983 | 990028 | 990072 | 990117 | 990161 | 990206 | 990250 | 990294 | 44 |
| 978 | 990339 | 990383 | 990428 | 990472 | 990516 | 990561 | 990605 | 990650 | 990694 | 990738 | 44 |
| 979 | 990783 | 990827 | 990871 | 990916 | 990960 | 991004 | 991049 | 991093 | 991137 | 991182 | 44 |
| 980 | 991226 | 991270 | 991315 | 991359 | 991403 | 991448 | 991492 | 991536 | 991580 | 991625 | 44 |
| 981 | 991669 | 991713 | 991757 | 991802 | 991846 | 991890 | 991934 | 991979 | 992023 | 992067 | 44 |
| 982 | 992111 | 992156 | 992200 | 992244 | 992288 | 992333 | 992377 | 992421 | 992465 | 992509 | 44 |
| 983 | 992553 | 992598 | 992642 | 992686 | 992730 | 992774 | 992818 | 992863 | 992907 | 992951 | 44 |
| 984 | 992995 | 993039 | 993083 | 993127 | 993172 | 993216 | 993260 | 993304 | 993348 | 993392 | 44 |
| 985 | 993436 | 993480 | 993524 | 993568 | 993613 | 993657 | 993701 | 993745 | 993789 | 993833 | 44 |
| 986 | 993877 | 993921 | 993965 | 994009 | 994053 | 994097 | 994141 | 994185 | 994229 | 994273 | 44 |
| 987 | 994317 | 994361 | 994405 | 994449 | 994493 | 994537 | 994581 | 994625 | 994669 | 994713 | 44 |
| 988 | 994757 | 994801 | 994845 | 994889 | 994933 | 994977 | 995021 | 995064 | 995108 | 995152 | 44 |
| 989 | 995196 | 995240 | 995284 | 995328 | 995372 | 995416 | 995460 | 995504 | 995547 | 995591 | 44 |
| 990 | 995635 | 995679 | 995723 | 995767 | 995811 | 995854 | 995898 | 995942 | 995986 | 996030 | 44 |
| 991 | 996074 | 996117 | 996161 | 996205 | 996249 | 996293 | 996336 | 996380 | 996424 | 996468 | 44 |
| 992 | 996512 | 996555 | 996599 | 996643 | 996687 | 996730 | 996774 | 996818 | 996862 | 996905 | 44 |
| 993 | 996949 | 996993 | 997037 | 997080 | 997124 | 997168 | 997212 | 997255 | 997299 | 997343 | 44 |
| 994 | 997386 | 997430 | 997474 | 997517 | 997561 | 997605 | 997648 | 997692 | 997736 | 997779 | 44 |
| 995 | 997823 | 997867 | 997910 | 997954 | 997998 | 998041 | 998085 | 998128 | 998172 | 998216 | 44 |
| 996 | 998259 | 998303 | 998346 | 998390 | 998434 | 998477 | 998521 | 998564 | 998608 | 998652 | 44 |
| 997 | 998695 | 998739 | 998782 | 998826 | 998869 | 998913 | 998956 | 999000 | 999043 | 999087 | 44 |
| 998 | 999130 | 999174 | 999218 | 999261 | 999305 | 999348 | 999392 | 999435 | 999478 | 999522 | 44 |
| 999 | 999565 | 999609 | 999652 | 999696 | 999739 | 999783 | 999826 | 999870 | 999913 | 999957 | 43 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

## LOGARITHMIC SINES AND TANGENTS.

| M | S | Sine. | Diff. | Tang. | S | M |
|---|---|---|---|---|---|---|
| | | 0 Degree. | | | | |
| 0 | 0 | | | | | 60 |
| | 10 | 5.685575 | 301030 | 5.685575 | 50 | |
| | 20 | 5.986605 | 176091 | 5.986605 | 40 | |
| | 30 | 6.162696 | 124939 | 6.162696 | 30 | |
| | 40 | 6.287635 | 96910 | 6.287635 | 20 | |
| | 50 | 6.384545 | 79181 | 6.384545 | 10 | |
| 1 | | 6.463726 | 66947 | 6.463726 | | 59 |
| | 10 | 6.530673 | 57992 | 6.530673 | 50 | |
| | 20 | 6.588665 | 51152 | 6.588665 | 40 | |
| | 30 | 6.639817 | 45758 | 6.639817 | 30 | |
| | 40 | 6.685575 | 41393 | 6.685575 | 20 | |
| | 50 | 6.726967 | 37789 | 6.726967 | 10 | |
| 2 | | 6.764756 | 34762 | 6.764756 | | 58 |
| | 10 | 6.799518 | 32185 | 6.799518 | 50 | |
| | 20 | 6.831703 | 29963 | 6.831703 | 40 | |
| | 30 | 6.861666 | 28029 | 6.861666 | 30 | |
| | 40 | 6.889695 | 26329 | 6.889695 | 20 | |
| | 50 | 6.916024 | 24823 | 6.916024 | 10 | |
| 3 | | 6.940847 | 23481 | 6.940847 | | 57 |
| | 10 | 6.964328 | 22276 | 6.964329 | 50 | |
| | 20 | 6.986605 | 21189 | 6.986605 | 40 | |
| | 30 | 7.007794 | 20203 | 7.007794 | 30 | |
| | 40 | 7.027997 | 19305 | 7.027998 | 20 | |
| | 50 | 7.047303 | 18483 | 7.047303 | 10 | |
| 4 | | 7.065786 | 17729 | 7.065786 | | 56 |
| | 10 | 7.083515 | 17033 | 7.083515 | 50 | |
| | 20 | 7.100548 | 16390 | 7.100548 | 40 | |
| | 30 | 7.116938 | 15795 | 7.116939 | 30 | |
| | 40 | 7.132733 | 15240 | 7.132733 | 20 | |
| | 50 | 7.147973 | 14723 | 7.147973 | 10 | |
| 5 | | 7.162696 | 14240 | 7.162696 | | 55 |
| | 10 | 7.176936 | 13788 | 7.176937 | 50 | |
| | 20 | 7.190725 | 13364 | 7.190725 | 40 | |
| | 30 | 7.204089 | 12965 | 7.204089 | 30 | |
| | 40 | 7.217054 | 12589 | 7.217054 | 20 | |
| | 50 | 7.229643 | 12234 | 7.229643 | 10 | |
| 6 | | 7.241877 | 11899 | 7.241878 | | 54 |
| | 10 | 7.253776 | 11582 | 7.253777 | 50 | |
| | 20 | 7.265358 | 11281 | 7.265359 | 40 | |
| | 30 | 7.276639 | 10995 | 7.276640 | 30 | |
| | 40 | 7.287635 | 10724 | 7.287635 | 20 | |
| | 50 | 7.298358 | 10466 | 7.298359 | 10 | |
| 7 | | 7.308824 | 10219 | 7.308825 | | 53 |
| | 10 | 7.319043 | 9984 | 7.319044 | 50 | |
| | 20 | 7.329027 | 9760 | 7.329028 | 40 | |
| | 30 | 7.338787 | 9545 | 7.338788 | 30 | |
| | 40 | 7.348332 | 9340 | 7.348333 | 20 | |
| | 50 | 7.357672 | 9144 | 7.357673 | 10 | |
| 8 | | 7.366816 | 8955 | 7.366817 | | 52 |
| | 10 | 7.375770 | 8774 | 7.375772 | 50 | |
| | 20 | 7.384544 | 8600 | 7.384546 | 40 | |
| | 30 | 7.393145 | 8433 | 7.393146 | 30 | |
| | 40 | 7.401578 | 8273 | 7.401579 | 20 | |
| | 50 | 7.409850 | 8118 | 7.409852 | 10 | |
| 9 | | 7.417968 | 7969 | 7.417970 | | 51 |
| | 10 | 7.425937 | 7825 | 7.425939 | 50 | |
| | 20 | 7.433762 | 7687 | 7.433764 | 40 | |
| | 30 | 7.441449 | 7553 | 7.441451 | 30 | |
| | 40 | 7.449002 | 7424 | 7.449004 | 20 | |
| | 50 | 7.456426 | 7299 | 7.456428 | 10 | |
| 10 | | 7.463725 | | 7.463727 | | 50 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |
| | | 89 Degrees. | | | | |

| M | S | Sine. | Diff. | Tang. | S | M |
|---|---|---|---|---|---|---|
| | | 0 Degree. | | | | |
| 10 | | 7.463725 | 7179 | 7.463727 | | 50 |
| | 10 | 7.470904 | 7062 | 7.470906 | 50 | |
| | 20 | 7.477966 | 6949 | 7.477968 | 40 | |
| | 30 | 7.484915 | 6839 | 7.484917 | 30 | |
| | 40 | 7.491754 | 6733 | 7.491756 | 20 | |
| | 50 | 7.498487 | 6631 | 7.498490 | 10 | |
| 11 | | 7.505118 | 6531 | 7.505120 | | 49 |
| | 10 | 7.511649 | 6434 | 7.511651 | 50 | |
| | 20 | 7.518083 | 6340 | 7.518085 | 40 | |
| | 30 | 7.524423 | 6249 | 7.524426 | 30 | |
| | 40 | 7.530672 | 6160 | 7.530675 | 20 | |
| | 50 | 7.536832 | 6074 | 7.536835 | 10 | |
| 12 | | 7.542906 | 5990 | 7.542909 | | 48 |
| | 10 | 7.548897 | 5909 | 7.548899 | 50 | |
| | 20 | 7.554808 | 5829 | 7.554808 | 40 | |
| | 30 | 7.560635 | 5752 | 7.560638 | 30 | |
| | 40 | 7.566387 | 5678 | 7.566390 | 20 | |
| | 50 | 7.572065 | 5603 | 7.572068 | 10 | |
| 13 | | 7.577668 | 5533 | 7.577671 | | 47 |
| | 10 | 7.583201 | 5463 | 7.583204 | 50 | |
| | 20 | 7.588664 | 5395 | 7.588667 | 40 | |
| | 30 | 7.594059 | 5329 | 7.594062 | 30 | |
| | 40 | 7.599388 | 5264 | 7.599391 | 20 | |
| | 50 | 7.604652 | 5201 | 7.604655 | 10 | |
| 14 | | 7.609853 | 5140 | 7.609857 | | 46 |
| | 10 | 7.614993 | 5079 | 7.614996 | 50 | |
| | 20 | 7.620072 | 5021 | 7.620076 | 40 | |
| | 30 | 7.625093 | 4963 | 7.625097 | 30 | |
| | 40 | 7.630056 | 4907 | 7.630060 | 20 | |
| | 50 | 7.634963 | 4852 | 7.634968 | 10 | |
| 15 | | 7.639816 | 4799 | 7.639820 | | 45 |
| | 10 | 7.644615 | 4746 | 7.644619 | 50 | |
| | 20 | 7.649361 | 4695 | 7.649366 | 40 | |
| | 30 | 7.654056 | 4645 | 7.654061 | 30 | |
| | 40 | 7.658701 | 4596 | 7.658706 | 20 | |
| | 50 | 7.663297 | 4548 | 7.663301 | 10 | |
| 16 | | 7.667844 | 4501 | 7.667849 | | 44 |
| | 10 | 7.672345 | 4454 | 7.672350 | 50 | |
| | 20 | 7.676799 | 4409 | 7.676804 | 40 | |
| | 30 | 7.681208 | 4365 | 7.681213 | 30 | |
| | 40 | 7.685573 | 4321 | 7.685578 | 20 | |
| | 50 | 7.689894 | 4279 | 7.689900 | 10 | |
| 17 | | 7.694173 | 4237 | 7.694179 | | 43 |
| | 10 | 7.698410 | 4196 | 7.698416 | 50 | |
| | 20 | 7.702606 | 4156 | 7.702612 | 40 | |
| | 30 | 7.706762 | 4117 | 7.706768 | 30 | |
| | 40 | 7.710879 | 4078 | 7.710885 | 20 | |
| | 50 | 7.714957 | 4040 | 7.714962 | 10 | |
| 18 | | 7.718997 | 4002 | 7.719003 | | 42 |
| | 10 | 7.722999 | 3966 | 7.723006 | 50 | |
| | 20 | 7.726965 | 3930 | 7.726972 | 40 | |
| | 30 | 7.730896 | 3895 | 7.730902 | 30 | |
| | 40 | 7.734791 | 3860 | 7.734797 | 20 | |
| | 50 | 7.738651 | 3826 | 7.738658 | 10 | |
| 19 | | 7.742477 | 3793 | 7.742484 | | 41 |
| | 10 | 7.746270 | 3760 | 7.746277 | 50 | |
| | 20 | 7.750031 | 3728 | 7.750037 | 40 | |
| | 30 | 7.753758 | 3696 | 7.753765 | 30 | |
| | 40 | 7.757454 | 3665 | 7.757462 | 20 | |
| | 50 | 7.761119 | 3634 | 7.761127 | 10 | |
| 20 | | 7.764754 | | 7.764761 | | 40 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |
| | | 89 Degrees. | | | | |

0 Degree.

| M | S | Sine. | Diff. | Tang. | S | M |
|---|---|---|---|---|---|---|
| 20 | 0 | 7.764754 | 3604 | 7.764761 | | 40 |
| | 10 | 7.768358 | 3575 | 7.768365 | 50 | |
| | 20 | 7.771932 | 3545 | 7.771940 | 40 | |
| | 30 | 7.775477 | 3517 | 7.775485 | 30 | |
| | 40 | 7.778994 | 3488 | 7.779002 | 20 | |
| | 50 | 7.782482 | 3461 | 7.782490 | 10 | |
| 21 | | 7.785943 | 3433 | 7.785951 | | 39 |
| | 10 | 7.789376 | 3406 | 7.789384 | 50 | |
| | 20 | 7.792782 | 3380 | 7.792790 | 40 | |
| | 30 | 7.796162 | 3354 | 7.796170 | 30 | |
| | 40 | 7.799515 | 3328 | 7.799524 | 20 | |
| | 50 | 7.802843 | 3303 | 7.802852 | 10 | |
| 22 | | 7.806146 | 3278 | 7.806155 | | 38 |
| | 10 | 7.809424 | 3253 | 7.809433 | 50 | |
| | 20 | 7.812677 | 3229 | 7.812686 | 40 | |
| | 30 | 7.815906 | 3205 | 7.815915 | 30 | |
| | 40 | 7.819111 | 3182 | 7.819120 | 20 | |
| | 50 | 7.822292 | 3158 | 7.822302 | 10 | |
| 23 | | 7.825451 | 3136 | 7.825460 | | 37 |
| | 10 | 7.828586 | 3114 | 7.828596 | 50 | |
| | 20 | 7.831700 | 3091 | 7.831710 | 40 | |
| | 30 | 7.834791 | 3069 | 7.834801 | 30 | |
| | 40 | 7.837860 | 3048 | 7.837870 | 20 | |
| | 50 | 7.840907 | 3026 | 7.840918 | 10 | |
| 24 | | 7.843934 | 3006 | 7.843944 | | 36 |
| | 10 | 7.846939 | 2985 | 7.846950 | 50 | |
| | 20 | 7.849924 | 2965 | 7.849935 | 40 | |
| | 30 | 7.852889 | 2944 | 7.852900 | 30 | |
| | 40 | 7.855833 | 2924 | 7.855844 | 20 | |
| | 50 | 7.858757 | 2905 | 7.858769 | 10 | |
| 25 | | 7.861662 | 2886 | 7.861674 | | 35 |
| | 10 | 7.864548 | 2867 | 7.864560 | 50 | |
| | 20 | 7.867415 | 2848 | 7.867426 | 40 | |
| | 30 | 7.870262 | 2830 | 7.870274 | 30 | |
| | 40 | 7.873092 | 2811 | 7.873104 | 20 | |
| | 50 | 7.875903 | 2793 | 7.875915 | 10 | |
| 26 | | 7.878695 | 2775 | 7.878708 | | 34 |
| | 10 | 7.881470 | 2757 | 7.881483 | 50 | |
| | 20 | 7.884228 | 2740 | 7.884240 | 40 | |
| | 30 | 7.886968 | 2723 | 7.886981 | 30 | |
| | 40 | 7.889691 | 2706 | 7.889704 | 20 | |
| | 50 | 7.892396 | 2689 | 7.892410 | 10 | |
| 27 | | 7.895085 | 2673 | 7.895099 | | 33 |
| | 10 | 7.897758 | 2656 | 7.897772 | 50 | |
| | 20 | 7.900414 | 2640 | 7.900428 | 40 | |
| | 30 | 7.903054 | 2624 | 7.903068 | 30 | |
| | 40 | 7.905678 | 2609 | 7.905692 | 20 | |
| | 50 | 7.908287 | 2593 | 7.908301 | 10 | |
| 28 | | 7.910879 | 2577 | 7.910894 | | 32 |
| | 10 | 7.913457 | 2562 | 7.913471 | 50 | |
| | 20 | 7.916019 | 2547 | 7.916034 | 40 | |
| | 30 | 7.918566 | 2532 | 7.918581 | 30 | |
| | 40 | 7.921098 | 2518 | 7.921113 | 20 | |
| | 50 | 7.923616 | 2503 | 7.923631 | 10 | |
| 29 | | 7.926119 | 2489 | 7.926134 | | 31 |
| | 10 | 7.928608 | 2475 | 7.928623 | 50 | |
| | 20 | 7.931082 | 2461 | 7.931098 | 40 | |
| | 30 | 7.933543 | 2447 | 7.933559 | 30 | |
| | 40 | 7.935990 | 2433 | 7.936006 | 20 | |
| | 50 | 7.938422 | 2420 | 7.938439 | 10 | |
| 30 | | 7.940842 | | 7.940858 | | 30 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |

89 Degrees.

0 Degree.

| M | S | Sine. | Diff. | Tang. | S | M |
|---|---|---|---|---|---|---|
| 30 | | 7.940842 | 2406 | 7.940858 | | 30 |
| | 10 | 7.943248 | 2393 | 7.943265 | 50 | |
| | 20 | 7.945641 | 2379 | 7.945658 | 40 | |
| | 30 | 7.948020 | 2367 | 7.948037 | 30 | |
| | 40 | 7.950387 | 2354 | 7.950404 | 20 | |
| | 50 | 7.952741 | 2341 | 7.952758 | 10 | |
| 31 | | 7.955082 | 2329 | 7.955100 | | 29 |
| | 10 | 7.957411 | 2316 | 7.957428 | 50 | |
| | 20 | 7.959727 | 2304 | 7.959745 | 40 | |
| | 30 | 7.962031 | 2292 | 7.962049 | 30 | |
| | 40 | 7.964322 | 2280 | 7.964341 | 20 | |
| | 50 | 7.966602 | 2268 | 7.966621 | 10 | |
| 32 | | 7.968870 | 2256 | 7.968889 | | 28 |
| | 10 | 7.971126 | 2244 | 7.971145 | 50 | |
| | 20 | 7.973370 | 2233 | 7.973389 | 40 | |
| | 30 | 7.975603 | 2221 | 7.975622 | 30 | |
| | 40 | 7.977824 | 2210 | 7.977844 | 20 | |
| | 50 | 7.980034 | 2199 | 7.980054 | 10 | |
| 33 | | 7.982233 | 2188 | 7.982253 | | 27 |
| | 10 | 7.984421 | 2177 | 7.984441 | 50 | |
| | 20 | 7.986598 | 2166 | 7.986619 | 40 | |
| | 30 | 7.988764 | 2155 | 7.988785 | 30 | |
| | 40 | 7.990919 | 2145 | 7.990940 | 20 | |
| | 50 | 7.993064 | 2134 | 7.993085 | 10 | |
| 34 | | 7.995198 | 2124 | 7.995219 | | 26 |
| | 10 | 7.997322 | 2113 | 7.997343 | 50 | |
| | 20 | 7.999435 | 2103 | 7.999457 | 40 | |
| | 30 | 8.001538 | 2093 | 8.001560 | 30 | |
| | 40 | 8.003631 | 2083 | 8.003653 | 20 | |
| | 50 | 8.005714 | 2073 | 8.005736 | 10 | |
| 35 | | 8.007787 | 2063 | 8.007809 | | 25 |
| | 10 | 8.009850 | 2053 | 8.009872 | 50 | |
| | 20 | 8.011903 | 2044 | 8.011926 | 40 | |
| | 30 | 8.013947 | 2034 | 8.013970 | 30 | |
| | 40 | 8.015981 | 2025 | 8.016004 | 20 | |
| | 50 | 8.018006 | 2015 | 8.018029 | 10 | |
| 36 | | 8.020021 | 2006 | 8.020045 | | 24 |
| | 10 | 8.022027 | 1997 | 8.022051 | 50 | |
| | 20 | 8.024023 | 1988 | 8.024048 | 40 | |
| | 30 | 8.026011 | 1978 | 8.026035 | 30 | |
| | 40 | 8.027989 | 1970 | 8.028014 | 20 | |
| | 50 | 8.029959 | 1961 | 8.029984 | 10 | |
| 37 | | 8.031920 | 1952 | 8.031945 | | 23 |
| | 10 | 8.033871 | 1943 | 8.033897 | 50 | |
| | 20 | 8.035814 | 1935 | 8.035840 | 40 | |
| | 30 | 8.037749 | 1926 | 8.037775 | 30 | |
| | 40 | 8.039675 | 1917 | 8.039701 | 20 | |
| | 50 | 8.041592 | 1909 | 8.041618 | 10 | |
| 38 | | 8.043501 | 1900 | 8.043527 | | 22 |
| | 10 | 8.045401 | 1893 | 8.045428 | 50 | |
| | 20 | 8.047294 | 1884 | 8.047321 | 40 | |
| | 30 | 8.049178 | 1876 | 8.049205 | 30 | |
| | 40 | 8.051054 | 1868 | 8.051081 | 20 | |
| | 50 | 8.052922 | 1860 | 8.052949 | 10 | |
| 39 | | 8.054781 | 1852 | 8.054809 | | 21 |
| | 10 | 8.056633 | 1844 | 8.056661 | 50 | |
| | 20 | 8.058477 | 1836 | 8.058506 | 40 | |
| | 30 | 8.060314 | 1828 | 8.060342 | 30 | |
| | 40 | 8.062142 | 1821 | 8.062171 | 20 | |
| | 50 | 8.063963 | 1813 | 8.063992 | 10 | |
| 40 | | 8.065776 | | 8.065806 | | 20 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |

89 Degrees.

## LOGARITHMIC SINES AND TANGENTS.

| 0 Degree. | | | | | | |
|---|---|---|---|---|---|---|
| M | S | Sine. | Diff. | Tang. | S | M |
| 40 | 0 | 8.065776 | | 8.065806 | | 20 |
| | 10 | 8.067582 | 1806 | 8.067612 | 50 | |
| | 20 | 8.069380 | 1798 | 8.069410 | 40 | |
| | 30 | 8.071171 | 1791 | 8.071201 | 30 | |
| | 40 | 8.072955 | 1784 | 8.072985 | 20 | |
| | 50 | 8.074731 | 1776 | 8.074761 | 10 | |
| 41 | | 8.076500 | 1769 | 8.076531 | | 19 |
| | 10 | 8.078261 | 1761 | 8.078293 | 50 | |
| | 20 | 8.080016 | 1755 | 8.080048 | 40 | |
| | 30 | 8.081764 | 1748 | 8.081795 | 30 | |
| | 40 | 8.083504 | 1740 | 8.083536 | 20 | |
| | 50 | 8.085238 | 1734 | 8.085270 | 10 | |
| 42 | | 8.086965 | 1727 | 8.086997 | | 18 |
| | 10 | 8.088685 | 1720 | 8.088717 | 50 | |
| | 20 | 8.090398 | 1713 | 8.090430 | 40 | |
| | 30 | 8.092104 | 1706 | 8.092137 | 30 | |
| | 40 | 8.093804 | 1700 | 8.093837 | 20 | |
| | 50 | 8.095497 | 1693 | 8.095530 | 10 | |
| 43 | | 8.097183 | 1686 | 8.097217 | | 17 |
| | 10 | 8.098863 | 1680 | 8.098897 | 50 | |
| | 20 | 8.100537 | 1674 | 8.100571 | 40 | |
| | 30 | 8.102204 | 1667 | 8.102239 | 30 | |
| | 40 | 8.103864 | 1660 | 8.103899 | 20 | |
| | 50 | 8.105519 | 1654 | 8.105554 | 10 | |
| 44 | | 8.107167 | 1648 | 8.107202 | | 16 |
| | 10 | 8.108809 | 1642 | 8.108845 | 50 | |
| | 20 | 8.110445 | 1636 | 8.110481 | 40 | |
| | 30 | 8.112074 | 1629 | 8.112110 | 30 | |
| | 40 | 8.113697 | 1623 | 8.113734 | 20 | |
| | 50 | 8.115315 | 1618 | 8.115352 | 10 | |
| 45 | | 8.116926 | 1611 | 8.116963 | | 15 |
| | 10 | 8.118532 | 1606 | 8.118569 | 50 | |
| | 20 | 8.120131 | 1599 | 8.120169 | 40 | |
| | 30 | 8.121725 | 1594 | 8.121763 | 30 | |
| | 40 | 8.123313 | 1588 | 8.123351 | 20 | |
| | 50 | 8.124895 | 1582 | 8.124933 | 10 | |
| 46 | | 8.126471 | 1576 | 8.126510 | | 14 |
| | 10 | 8.128042 | 1571 | 8.128081 | 50 | |
| | 20 | 8.129607 | 1565 | 8.129646 | 40 | |
| | 30 | 8.131166 | 1559 | 8.131206 | 30 | |
| | 40 | 8.132720 | 1554 | 8.132760 | 20 | |
| | 50 | 8.134268 | 1548 | 8.134308 | 10 | |
| 47 | | 8.135810 | 1542 | 8.135851 | | 13 |
| | 10 | 8.137348 | 1538 | 8.137389 | 50 | |
| | 20 | 8.138880 | 1532 | 8.138921 | 40 | |
| | 30 | 8.140406 | 1526 | 8.140447 | 30 | |
| | 40 | 8.141927 | 1521 | 8.141969 | 20 | |
| | 50 | 8.143443 | 1516 | 8.143485 | 10 | |
| 48 | | 8.144953 | 1510 | 8.144996 | | 12 |
| | 10 | 8.146459 | 1506 | 8.146501 | 50 | |
| | 20 | 8.147959 | 1501 | 8.148002 | 40 | |
| | 30 | 8.149453 | 1494 | 8.149497 | 30 | |
| | 40 | 8.150943 | 1490 | 8.150987 | 20 | |
| | 50 | 8.152428 | 1485 | 8.152472 | 10 | |
| 49 | | 8.153907 | 1479 | 8.153952 | | 11 |
| | 10 | 8.155382 | 1475 | 8.155426 | 50 | |
| | 20 | 8.156852 | 1470 | 8.156896 | 40 | |
| | 30 | 8.158316 | 1465 | 8.158361 | 30 | |
| | 40 | 8.159776 | 1460 | 8.159821 | 20 | |
| | 50 | 8.161231 | 1455 | 8.161276 | 10 | |
| 50 | | 8.162681 | 1450 | 8.162727 | | 10 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |
| 89 Degrees. | | | | | | |

| 0 Degree. | | | | | | |
|---|---|---|---|---|---|---|
| M | S | Sine. | Diff. | Tang. | S | M |
| 50 | 0 | 8.162681 | | 8.162727 | | 10 |
| | 10 | 8.164126 | 1445 | 8.164172 | 50 | |
| | 20 | 8.165566 | 1440 | 8.165613 | 40 | |
| | 30 | 8.167002 | 1436 | 8.167049 | 30 | |
| | 40 | 8.168433 | 1431 | 8.168480 | 20 | |
| | 50 | 8.169859 | 1426 | 8.169906 | 10 | |
| 51 | | 8.171280 | 1421 | 8.171328 | | 9 |
| | 10 | 8.172697 | 1417 | 8.172745 | 50 | |
| | 20 | 8.174109 | 1412 | 8.174158 | 40 | |
| | 30 | 8.175517 | 1408 | 8.175566 | 30 | |
| | 40 | 8.176920 | 1403 | 8.176969 | 20 | |
| | 50 | 8.178319 | 1399 | 8.178368 | 10 | |
| 52 | | 8.179713 | 1394 | 8.179763 | | 8 |
| | 10 | 8.181102 | 1389 | 8.181152 | 50 | |
| | 20 | 8.182488 | 1386 | 8.182538 | 40 | |
| | 30 | 8.183869 | 1381 | 8.183919 | 30 | |
| | 40 | 8.185245 | 1376 | 8.185296 | 20 | |
| | 50 | 8.186617 | 1372 | 8.186668 | 10 | |
| 53 | | 8.187985 | 1368 | 8.188036 | | 7 |
| | 10 | 8.189348 | 1363 | 8.189400 | 50 | |
| | 20 | 8.190707 | 1359 | 8.190760 | 40 | |
| | 30 | 8.192062 | 1355 | 8.192115 | 30 | |
| | 40 | 8.193413 | 1351 | 8.193466 | 20 | |
| | 50 | 8.194760 | 1347 | 8.194813 | 10 | |
| 54 | | 8.196102 | 1342 | 8.196156 | | 6 |
| | 10 | 8.197440 | 1338 | 8.197494 | 50 | |
| | 20 | 8.198774 | 1334 | 8.198829 | 40 | |
| | 30 | 8.200104 | 1330 | 8.200159 | 30 | |
| | 40 | 8.201430 | 1326 | 8.201485 | 20 | |
| | 50 | 8.202752 | 1322 | 8.202808 | 10 | |
| 55 | | 8.204070 | 1318 | 8.204126 | | 5 |
| | 10 | 8.205384 | 1314 | 8.205440 | 50 | |
| | 20 | 8.206694 | 1310 | 8.206750 | 40 | |
| | 30 | 8.208000 | 1306 | 8.208057 | 30 | |
| | 40 | 8.209302 | 1302 | 8.209359 | 20 | |
| | 50 | 8.210601 | 1299 | 8.210658 | 10 | |
| 56 | | 8.211895 | 1294 | 8.211953 | | 4 |
| | 10 | 8.213185 | 1290 | 8.213243 | 50 | |
| | 20 | 8.214472 | 1287 | 8.214530 | 40 | |
| | 30 | 8.215755 | 1283 | 8.215814 | 30 | |
| | 40 | 8.217034 | 1279 | 8.217093 | 20 | |
| | 50 | 8.218309 | 1275 | 8.218369 | 10 | |
| 57 | | 8.219581 | 1272 | 8.219641 | | 3 |
| | 10 | 8.220849 | 1268 | 8.220909 | 50 | |
| | 20 | 8.222113 | 1264 | 8.222174 | 40 | |
| | 30 | 8.223374 | 1261 | 8.223435 | 30 | |
| | 40 | 8.224631 | 1257 | 8.224692 | 20 | |
| | 50 | 8.225884 | 1253 | 8.225945 | 10 | |
| 58 | | 8.227134 | 1250 | 8.227195 | | 2 |
| | 10 | 8.228380 | 1246 | 8.228442 | 50 | |
| | 20 | 8.229622 | 1242 | 8.229685 | 40 | |
| | 30 | 8.230861 | 1239 | 8.230924 | 30 | |
| | 40 | 8.232096 | 1235 | 8.232160 | 20 | |
| | 50 | 8.233328 | 1232 | 8.233392 | 10 | |
| 59 | | 8.234557 | 1229 | 8.234621 | | 1 |
| | 10 | 8.235782 | 1225 | 8.235846 | 50 | |
| | 20 | 8.237003 | 1222 | 8.237068 | 40 | |
| | 30 | 8.238221 | 1218 | 8.238286 | 30 | |
| | 40 | 8.239436 | 1215 | 8.239501 | 20 | |
| | 50 | 8.240647 | 1211 | 8.240713 | 10 | |
| 60 | | 8.241855 | 1208 | 8.241921 | | 0 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |
| 89 Degrees. | | | | | | |

## LOGARITHMIC SINES AND TANGENTS.

| 1 Degree. | | | | | | | 1 Degree. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | S | Sine. | Diff. | Tang. | S | M | M | S | Sine. | Diff. | Tang. | S | M |
| 0 | 0 | 8.241855 | | 8.241921 | | 60 | 10 | 0 | 8.308794 | | 8.308884 | | 50 |
| | 10 | 8.243060 | 1205 | 8.243126 | 50 | | | 10 | 8.309827 | 1033 | 8.309917 | 50 | |
| | 20 | 8.244261 | 1201 | 8.244328 | 40 | | | 20 | 8.310857 | 1030 | 8.310948 | 40 | |
| | 30 | 8.245459 | 1198 | 8.245526 | 30 | | | 30 | 8.311885 | 1028 | 8.311976 | 30 | |
| | 40 | 8.246654 | 1195 | 8.246721 | 20 | | | 40 | 8.312910 | 1025 | 8.313002 | 20 | |
| | 50 | 8.247845 | 1191 | 8.247913 | 10 | | | 50 | 8.313933 | 1023 | 8.314025 | 10 | |
| 1 | | 8.249033 | 1188 | 8.249101 | | 59 | 11 | | 8.314954 | 1021 | 8.315046 | | 49 |
| | 10 | 8.250218 | 1185 | 8.250287 | 50 | | | 10 | 8.315972 | 1018 | 8.316065 | 50 | |
| | 20 | 8.251400 | 1182 | 8.251469 | 40 | | | 20 | 8.316987 | 1015 | 8.317081 | 40 | |
| | 30 | 8.252578 | 1178 | 8.252648 | 30 | | | 30 | 8.318001 | 1014 | 8.318095 | 30 | |
| | 40 | 8.253753 | 1175 | 8.253823 | 20 | | | 40 | 8.319012 | 1011 | 8.319106 | 20 | |
| | 50 | 8.254925 | 1172 | 8.254996 | 10 | | | 50 | 8.320020 | 1008 | 8.320115 | 10 | |
| 2 | | 8.256094 | 1169 | 8.256165 | | 58 | 12 | | 8.321027 | 1007 | 8.321122 | | 48 |
| | 10 | 8.257260 | 1166 | 8.257331 | 50 | | | 10 | 8.322031 | 1004 | 8.322127 | 50 | |
| | 20 | 8.258423 | 1163 | 8.258494 | 40 | | | 20 | 8.323033 | 1002 | 8.323129 | 40 | |
| | 30 | 8.259582 | 1159 | 8.259654 | 30 | | | 30 | 8.324032 | 999 | 8.324128 | 30 | |
| | 40 | 8.260739 | 1157 | 8.260811 | 20 | | | 40 | 8.325029 | 997 | 8.325126 | 20 | |
| | 50 | 8.261892 | 1153 | 8.261965 | 10 | | | 50 | 8.326024 | 995 | 8.326121 | 10 | |
| 3 | | 8.263042 | 1150 | 8.263115 | | 57 | 13 | | 8.327016 | 992 | 8.327114 | | 47 |
| | 10 | 8.264190 | 1148 | 8.264263 | 50 | | | 10 | 8.328007 | 991 | 8.328105 | 50 | |
| | 20 | 8.265334 | 1144 | 8.265408 | 40 | | | 20 | 8.328995 | 988 | 8.329093 | 40 | |
| | 30 | 8.266475 | 1141 | 8.266549 | 30 | | | 30 | 8.329980 | 986 | 8.330080 | 30 | |
| | 40 | 8.267613 | 1138 | 8.267688 | 20 | | | 40 | 8.330964 | 984 | 8.331064 | 20 | |
| | 50 | 8.268749 | 1136 | 8.268824 | 10 | | | 50 | 8.331945 | 981 | 8.332045 | 10 | |
| 4 | | 8.269881 | 1132 | 8.269956 | | 56 | 14 | | 8.332924 | 979 | 8.333025 | | 46 |
| | 10 | 8.271010 | 1129 | 8.271086 | 50 | | | 10 | 8.333901 | 977 | 8.334002 | 50 | |
| | 20 | 8.272137 | 1127 | 8.272213 | 40 | | | 20 | 8.334876 | 975 | 8.334977 | 40 | |
| | 30 | 8.273260 | 1124 | 8.273337 | 30 | | | 30 | 8.335848 | 972 | 8.335950 | 30 | |
| | 40 | 8.274381 | 1121 | 8.274458 | 20 | | | 40 | 8 336819 | 971 | 8.336921 | 20 | |
| | 50 | 8.275499 | 1118 | 8.275576 | 10 | | | 50 | 8.337787 | 968 | 8.337890 | 10 | |
| 5 | | 8.276614 | 1115 | 8.276691 | | 55 | 15 | | 8.338753 | 966 | 8.338856 | | 45 |
| | 10 | 8.277726 | 1112 | 8.277804 | 50 | | | 10 | 8.339717 | 964 | 8.339821 | 50 | |
| | 20 | 8.278835 | 1109 | 8.278913 | 40 | | | 20 | 8.340678 | 961 | 8.340783 | 40 | |
| | 30 | 8.279941 | 1106 | 8.280020 | 30 | | | 30 | 8.341638 | 960 | 8.341743 | 30 | |
| | 40 | 8.281045 | 1104 | 8.281124 | 20 | | | 40 | 8.342596 | 958 | 8.342701 | 20 | |
| | 50 | 8.282145 | 1101 | 8.282225 | 10 | | | 50 | 8.343551 | 955 | 8.343657 | 10 | |
| 6 | | 8.283243 | 1098 | 8.283323 | | 54 | 16 | | 8.344504 | 953 | 8.344610 | | 44 |
| | 10 | 8.284339 | 1096 | 8.284419 | 50 | | | 10 | 8.345455 | 951 | 8.345562 | 50 | |
| | 20 | 8.285431 | 1093 | 8.285512 | 40 | | | 20 | 8.346405 | 950 | 8.346512 | 40 | |
| | 30 | 8.286521 | 1090 | 8.286602 | 30 | | | 30 | 8.347352 | 947 | 8.347459 | 30 | |
| | 40 | 8.287608 | 1087 | 8.287689 | 20 | | | 40 | 8.348297 | 945 | 8.348405 | 20 | |
| | 50 | 8.288692 | 1084 | 8.288774 | 10 | | | 50 | 8.349240 | 943 | 8.349348 | 10 | |
| 7 | | 8.289773 | 1081 | 8.289856 | | 53 | 17 | | 8.350180 | 940 | 8.350289 | | 43 |
| | 10 | 8.290852 | 1079 | 8.290935 | 50 | | | 10 | 8.351119 | 939 | 8.351229 | 50 | |
| | 20 | 8.291929 | 1077 | 8.292012 | 40 | | | 20 | 8.352056 | 937 | 8.352166 | 40 | |
| | 30 | 8.293002 | 1073 | 8.293086 | 30 | | | 30 | 8.352991 | 935 | 8.353101 | 30 | |
| | 40 | 8.294073 | 1071 | 8.294157 | 20 | | | 40 | 8.353924 | 933 | 8.354035 | 20 | |
| | 50 | 8.295141 | 1068 | 8.295226 | 10 | | | 50 | 8.354855 | 931 | 8.354966 | 10 | |
| 8 | | 8.296207 | 1066 | 8.296292 | | 52 | 18 | | 8.355783 | 928 | 8.355895 | | 42 |
| | 10 | 8.297270 | 1063 | 8.297355 | 50 | | | 10 | 8.356710 | 927 | 8.356823 | 50 | |
| | 20 | 8.298330 | 1060 | 8.298416 | 40 | | | 20 | 8.357635 | 925 | 8.357748 | 40 | |
| | 30 | 8.299388 | 1058 | 8.299474 | 30 | | | 30 | 8.358558 | 923 | 8.358671 | 30 | |
| | 40 | 8.300443 | 1055 | 8.300530 | 20 | | | 40 | 8.359479 | 921 | 8.359593 | 20 | |
| | 50 | 8.301496 | 1053 | 8.301583 | 10 | | | 50 | 8.360398 | 919 | 8.360512 | 10 | |
| 9 | | 8.302546 | 1050 | 8.302633 | | 51 | 19 | | 8.361315 | 917 | 8.361430 | | 41 |
| | 10 | 8.303594 | 1048 | 8.303682 | 50 | | | 10 | 8.362230 | 915 | 8.362345 | 50 | |
| | 20 | 8.304639 | 1045 | 8.304727 | 40 | | | 20 | 8.363143 | 913 | 8.363259 | 40 | |
| | 30 | 8.305681 | 1042 | 8.305770 | 30 | | | 30 | 8.364054 | 911 | 8.364171 | 30 | |
| | 40 | 8.306721 | 1040 | 8.306811 | 20 | | | 40 | 8.364964 | 910 | 8.365080 | 20 | |
| | 50 | 8.307759 | 1038 | 8.307849 | 10 | | | 50 | 8.365871 | 907 | 8.365988 | 10 | |
| 10 | | 8.308794 | 1035 | 8.308884 | | 50 | 20 | | 8.366777 | 906 | 8.366894 | | 40 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M | M | S | Co-sine. | Diff. | Co-tan. | S | M |
| 88 Degrees. | | | | | | | 88 Degrees. | | | | | | |

# TABLE XXV.

## LOGARITHMIC SINES AND TANGENTS.

| 1 Degree. | | | | | | |
|---|---|---|---|---|---|---|
| M | S | Sine. | Diff. | Tang. | S | M |
| 20 | 0 | 8.366777 | 904 | 8.366894 | | 40 |
| | 10 | 8.367681 | 901 | 8.367799 | 50 | |
| | 20 | 8.368582 | 900 | 8.368701 | 40 | |
| | 30 | 8.369482 | 898 | 8.369601 | 30 | |
| | 40 | 8.370380 | 897 | 8.370500 | 20 | |
| | 50 | 8.371277 | 894 | 8.371397 | 10 | |
| 21 | | 8.372171 | 893 | 8.372291 | | 39 |
| | 10 | 8.373064 | 891 | 8.373184 | 50 | |
| | 20 | 8.373955 | 888 | 8.374076 | 40 | |
| | 30 | 8.374843 | 887 | 8.374965 | 30 | |
| | 40 | 8.375730 | 885 | 8.375853 | 20 | |
| | 50 | 8.376615 | 884 | 8.376738 | 10 | |
| 22 | | 8.377499 | 881 | 8.377622 | | 38 |
| | 10 | 8.378380 | 880 | 8.378504 | 50 | |
| | 20 | 8.379260 | 878 | 8.379385 | 40 | |
| | 30 | 8.380138 | 877 | 8.380263 | 30 | |
| | 40 | 8.381015 | 874 | 8.381140 | 20 | |
| | 50 | 8.381889 | 873 | 8.382015 | 10 | |
| 23 | | 8.382762 | 871 | 8.382889 | | 37 |
| | 10 | 8.383633 | 869 | 8.383760 | 50 | |
| | 20 | 8.384502 | 868 | 8.384630 | 40 | |
| | 30 | 8.385370 | 866 | 8.385498 | 30 | |
| | 40 | 8.386236 | 864 | 8.386364 | 20 | |
| | 50 | 8.387100 | 862 | 8.287229 | 10 | |
| 24 | | 8.387962 | 861 | 8.388092 | | 36 |
| | 10 | 8.388823 | 859 | 8.388953 | 50 | |
| | 20 | 8.389682 | 857 | 8.389812 | 40 | |
| | 30 | 8.390539 | 856 | 8.390670 | 30 | |
| | 40 | 8.391395 | 854 | 8.391526 | 20 | |
| | 50 | 8.392249 | 852 | 8.392381 | 10 | |
| 25 | | 8.393101 | 850 | 8.393234 | | 35 |
| | 10 | 8.393951 | 849 | 8.394085 | 50 | |
| | 20 | 8.394800 | 847 | 8.394934 | 40 | |
| | 30 | 8.395647 | 846 | 8.395782 | 30 | |
| | 40 | 8.396493 | 844 | 8.396628 | 20 | |
| | 50 | 8.397337 | 842 | 8.397472 | 10 | |
| 26 | | 8.398179 | 841 | 8.398315 | | 34 |
| | 10 | 8.399020 | 839 | 8.399156 | 50 | |
| | 20 | 8.399859 | 837 | 8.399996 | 40 | |
| | 30 | 8.400696 | 836 | 8.400834 | 30 | |
| | 40 | 8.401532 | 834 | 8.401670 | 20 | |
| | 50 | 8.402366 | 833 | 8.402505 | 10 | |
| 27 | | 8.403199 | 831 | 8.403338 | | 33 |
| | 10 | 8.404030 | 829 | 8.404170 | 50 | |
| | 20 | 8.404859 | 828 | 8.405000 | 40 | |
| | 30 | 8.405687 | 826 | 8.405828 | 30 | |
| | 40 | 8.406513 | 825 | 8.406655 | 20 | |
| | 50 | 8.407338 | 823 | 8.407480 | 10 | |
| 28 | | 8.408161 | 822 | 8.408304 | | 32 |
| | 10 | 8.408983 | 820 | 8.409126 | 50 | |
| | 20 | 8.409803 | 818 | 8.409946 | 40 | |
| | 30 | 8.410621 | 817 | 8.410765 | 30 | |
| | 40 | 8.411438 | 816 | 8.411583 | 20 | |
| | 50 | 8.412254 | 814 | 8.412399 | 10 | |
| 29 | | 8.413068 | 812 | 8.413213 | | 31 |
| | 10 | 8.413880 | 811 | 8.414026 | 50 | |
| | 20 | 8.414691 | 809 | 8.414837 | 40 | |
| | 30 | 8.415500 | 808 | 8.415647 | 30 | |
| | 40 | 8.416308 | 806 | 8.416456 | 20 | |
| | 50 | 8.417114 | 805 | 8.417262 | 10 | |
| 30 | | 8.417919 | | 8.418068 | | 30 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |
| 88 Degrees. | | | | | | |

| 1 Degree. | | | | | | |
|---|---|---|---|---|---|---|
| M | S | Sine. | Diff. | Tang. | S | M |
| 30 | 0 | 8.417919 | 803 | 8.418068 | | 30 |
| | 10 | 8.418722 | 802 | 8.418872 | 50 | |
| | 20 | 8.419524 | 800 | 8.419674 | 40 | |
| | 30 | 8.420324 | 799 | 8.420475 | 30 | |
| | 40 | 8.421123 | 798 | 8.421274 | 20 | |
| | 50 | 8.421921 | 796 | 8.422073 | 10 | |
| 31 | | 8.422717 | 794 | 8.422869 | | 29 |
| | 10 | 8.423511 | 793 | 8.423664 | 50 | |
| | 20 | 8.424304 | 792 | 8.424458 | 40 | |
| | 30 | 8.425096 | 790 | 8.425250 | 30 | |
| | 40 | 8.425886 | 789 | 8.426040 | 20 | |
| | 50 | 8.426675 | 787 | 8.426830 | 10 | |
| 32 | | 8.427462 | 786 | 8.427618 | | 28 |
| | 10 | 8.428248 | 784 | 8.428404 | 50 | |
| | 20 | 8.429032 | 783 | 8.429189 | 40 | |
| | 30 | 8.429815 | 782 | 8.429973 | 30 | |
| | 40 | 8.430597 | 780 | 8.430755 | 20 | |
| | 50 | 8.431377 | 779 | 8.431536 | 10 | |
| 33 | | 8.432156 | 777 | 8.432315 | | 27 |
| | 10 | 8.432933 | 776 | 8.433093 | 50 | |
| | 20 | 8.433709 | 775 | 8.433870 | 40 | |
| | 30 | 8.434484 | 773 | 8.434645 | 30 | |
| | 40 | 8.435257 | 772 | 8.435419 | 20 | |
| | 50 | 8.436029 | 771 | 8.436191 | 10 | |
| 34 | | 8.436800 | 769 | 8.436962 | | 26 |
| | 10 | 8.437569 | 768 | 8.437732 | 50 | |
| | 20 | 8.438337 | 766 | 8.438500 | 40 | |
| | 30 | 8.439103 | 765 | 8.439267 | 30 | |
| | 40 | 8.439868 | 764 | 8.440033 | 20 | |
| | 50 | 8.440632 | 762 | 8.440797 | 10 | |
| 35 | | 8.441394 | 761 | 8.441560 | | 25 |
| | 10 | 8.442155 | 760 | 8.442322 | 50 | |
| | 20 | 8.442915 | 759 | 8.443082 | 40 | |
| | 30 | 8.443674 | 757 | 8.443841 | 30 | |
| | 40 | 8.444431 | 756 | 8.444599 | 20 | |
| | 50 | 8.445187 | 754 | 8.445355 | 10 | |
| 36 | | 8.445941 | 753 | 8.446110 | | 24 |
| | 10 | 8.446694 | 752 | 8.446864 | 50 | |
| | 20 | 8.447446 | 751 | 8.447616 | 40 | |
| | 30 | 8.448196 | 750 | 8.448367 | 30 | |
| | 40 | 8.448946 | 748 | 8.449117 | 20 | |
| | 50 | 8.449694 | 747 | 8.449866 | 10 | |
| 37 | | 8.450440 | 746 | 8.450613 | | 23 |
| | 10 | 8.451186 | 744 | 8.451359 | 50 | |
| | 20 | 8.451930 | 743 | 8.452104 | 40 | |
| | 30 | 8.452673 | 741 | 8.452847 | 30 | |
| | 40 | 8.453414 | 740 | 8.453589 | 20 | |
| | 50 | 8.454154 | 739 | 8.454330 | 10 | |
| 38 | | 8.454893 | 738 | 8.455070 | | 22 |
| | 10 | 8.455631 | 737 | 8.455808 | 50 | |
| | 20 | 8.456368 | 735 | 8.456545 | 40 | |
| | 30 | 8.457103 | 734 | 8.457281 | 30 | |
| | 40 | 8.457837 | 733 | 8.458016 | 20 | |
| | 50 | 8.458570 | 732 | 8.458749 | 10 | |
| 39 | | 8.459301 | 731 | 8.459481 | | 21 |
| | 10 | 8.460032 | 729 | 8.460212 | 50 | |
| | 20 | 8.460761 | 728 | 8.460942 | 40 | |
| | 30 | 8.461489 | 727 | 8.461671 | 30 | |
| | 40 | 8.462215 | 726 | 8.462398 | 20 | |
| | 50 | 8.462941 | 724 | 8.463124 | 10 | |
| 40 | | 8.463665 | | 8.463849 | | 20 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |
| 88 Degrees. | | | | | | |

1 Degree.

| M | S | Sine. | Diff. | Tang. | S | M |
|---|---|---|---|---|---|---|
| 40 | 0 | 8.463665 | | 8.463849 | | 20 |
| | 10 | 8.464388 | 723 | 8.464572 | 50 | |
| | 20 | 8.465110 | 722 | 8.465295 | 40 | |
| | 30 | 8.465830 | 721 | 8.466016 | 30 | |
| | 40 | 8.466550 | 720 | 8.466736 | 20 | |
| | 50 | 8.467268 | 718 | 8.467455 | 10 | |
| 41 | | 8.467985 | 717 | 8.468172 | | 19 |
| | 10 | 8.468701 | 716 | 8.468889 | 50 | |
| | 20 | 8.469416 | 715 | 8.469604 | 40 | |
| | 30 | 8.470129 | 714 | 8.470318 | 30 | |
| | 40 | 8.470841 | 713 | 8.471031 | 20 | |
| | 50 | 8.471553 | 712 | 8.471743 | 10 | |
| 42 | | 8.472263 | 710 | 8.472454 | | 18 |
| | 10 | 8.472971 | 709 | 8.473163 | 50 | |
| | 20 | 8.473679 | 708 | 8.473871 | 40 | |
| | 30 | 8.474386 | 707 | 8.474579 | 30 | |
| | 40 | 8.475091 | 706 | 8.475285 | 20 | |
| | 50 | 8.475795 | 704 | 8.475990 | 10 | |
| 43 | | 8.476498 | 703 | 8.476693 | | 17 |
| | 10 | 8.477200 | 702 | 8.477396 | 50 | |
| | 20 | 8.477901 | 701 | 8.478097 | 40 | |
| | 30 | 8.478601 | 700 | 8.478798 | 30 | |
| | 40 | 8.479299 | 699 | 8.479497 | 20 | |
| | 50 | 8.479997 | 698 | 8.480195 | 10 | |
| 44 | | 8.480693 | 696 | 8.480892 | | 16 |
| | 10 | 8.481388 | 695 | 8.481588 | 50 | |
| | 20 | 8.482082 | 694 | 8.482283 | 40 | |
| | 30 | 8.482775 | 693 | 8.482976 | 30 | |
| | 40 | 8.483467 | 692 | 8.483669 | 20 | |
| | 50 | 8.484158 | 691 | 8.484360 | 10 | |
| 45 | | 8.484848 | 690 | 8.485050 | | 15 |
| | 10 | 8.485537 | 689 | 8.485740 | 50 | |
| | 20 | 8.486224 | 687 | 8.486428 | 40 | |
| | 30 | 8.486910 | 686 | 8.487115 | 30 | |
| | 40 | 8.487596 | 686 | 8.487801 | 20 | |
| | 50 | 8.488280 | 684 | 8.488486 | 10 | |
| 46 | | 8.488963 | 683 | 8.489170 | | 14 |
| | 10 | 8.489645 | 682 | 8.489852 | 50 | |
| | 20 | 8.490326 | 681 | 8.490534 | 40 | |
| | 30 | 8.491006 | 680 | 8.491215 | 30 | |
| | 40 | 8.491685 | 679 | 8.491894 | 20 | |
| | 50 | 8.492363 | 678 | 8.492573 | 10 | |
| 47 | | 8.493040 | 677 | 8.493250 | | 13 |
| | 10 | 8.493716 | 676 | 8.493927 | 50 | |
| | 20 | 8.494390 | 675 | 8.494602 | 40 | |
| | 30 | 8.495064 | 674 | 8.495276 | 30 | |
| | 40 | 8.495736 | 673 | 8.495949 | 20 | |
| | 50 | 8.496408 | 672 | 8.496622 | 10 | |
| 48 | | 8.497078 | 671 | 8.497293 | | 12 |
| | 10 | 8.497748 | 670 | 8.497963 | 50 | |
| | 20 | 8.498416 | 669 | 8.498632 | 40 | |
| | 30 | 8.499084 | 668 | 8.499300 | 30 | |
| | 40 | 8.499750 | 667 | 8.499967 | 20 | |
| | 50 | 8.500415 | 666 | 8.500633 | 10 | |
| 49 | | 8.501080 | 665 | 8.501298 | | 11 |
| | 10 | 8.501743 | 664 | 8.501962 | 50 | |
| | 20 | 8.502405 | 663 | 8.502625 | 40 | |
| | 30 | 8.503067 | 662 | 8.503287 | 30 | |
| | 40 | 8.503727 | 660 | 8.503948 | 20 | |
| | 50 | 8.504386 | 659 | 8.504608 | 10 | |
| 50 | | 8.505045 | 659 | 8.505267 | | 10 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |

88 Degrees.

1 Degree.

| M | S | Sine. | Diff. | Tang. | S | M |
|---|---|---|---|---|---|---|
| 50 | 0 | 8.505045 | | 8.505267 | | 10 |
| | 10 | 8.505702 | 658 | 8.505925 | 50 | |
| | 20 | 8.506358 | 657 | 8.506582 | 40 | |
| | 30 | 8.507014 | 656 | 8.507238 | 30 | |
| | 40 | 8.507668 | 655 | 8.507893 | 20 | |
| | 50 | 8.508321 | 654 | 8.508547 | 10 | |
| 51 | | 8.508974 | 653 | 8.509200 | | 9 |
| | 10 | 8.509625 | 652 | 8.509852 | 50 | |
| | 20 | 8.510275 | 651 | 8.510503 | 40 | |
| | 30 | 8.510925 | 650 | 8.511153 | 30 | |
| | 40 | 8.511573 | 649 | 8.511802 | 20 | |
| | 50 | 8.512221 | 648 | 8.512451 | 10 | |
| 52 | | 8.512867 | 647 | 8.513098 | | 8 |
| | 10 | 8.513513 | 646 | 8.513744 | 50 | |
| | 20 | 8.514157 | 645 | 8.514389 | 40 | |
| | 30 | 8.514801 | 644 | 8.515034 | 30 | |
| | 40 | 8.515444 | 643 | 8.515677 | 20 | |
| | 50 | 8.516086 | 642 | 8.516320 | 10 | |
| 53 | | 8.516726 | 641 | 8.516961 | | 7 |
| | 10 | 8.517366 | 640 | 8.517602 | 50 | |
| | 20 | 8.518005 | 639 | 8.518241 | 40 | |
| | 30 | 8.518643 | 638 | 8.518880 | 30 | |
| | 40 | 8.519280 | 637 | 8.519517 | 20 | |
| | 50 | 8.519916 | 636 | 8.520154 | 10 | |
| 54 | | 8.520551 | 635 | 8.520790 | | 6 |
| | 10 | 8.521186 | 635 | 8.521425 | 50 | |
| | 20 | 8.521819 | 634 | 8.522059 | 40 | |
| | 30 | 8.522451 | 633 | 8.522692 | 30 | |
| | 40 | 8.523083 | 632 | 8.523324 | 20 | |
| | 50 | 8.523713 | 631 | 8.523956 | 10 | |
| 55 | | 8.524343 | 630 | 8.524586 | | 5 |
| | 10 | 8.524972 | 629 | 8.525215 | 50 | |
| | 20 | 8.525600 | 628 | 8.525844 | 40 | |
| | 30 | 8.526226 | 627 | 8.526472 | 30 | |
| | 40 | 8.526852 | 626 | 8.527098 | 20 | |
| | 50 | 8.527477 | 625 | 8.527724 | 10 | |
| 56 | | 8.528102 | 625 | 8.528349 | | 4 |
| | 10 | 8.528725 | 624 | 8.528973 | 50 | |
| | 20 | 8.529347 | 623 | 8.529596 | 40 | |
| | 30 | 8.529969 | 622 | 8.530218 | 30 | |
| | 40 | 8.530589 | 621 | 8.530840 | 20 | |
| | 50 | 8.531209 | 620 | 8.531460 | 10 | |
| 57 | | 8.531828 | 619 | 8.532080 | | 3 |
| | 10 | 8.532446 | 618 | 8.532698 | 50 | |
| | 20 | 8.533063 | 617 | 8.533316 | 40 | |
| | 30 | 8.533679 | 616 | 8.533933 | 30 | |
| | 40 | 8.534295 | 616 | 8.534549 | 20 | |
| | 50 | 8.534909 | 615 | 8.535164 | 10 | |
| 58 | | 8.535523 | 614 | 8.535779 | | 2 |
| | 10 | 8.536136 | 613 | 8.536392 | 50 | |
| | 20 | 8.536747 | 612 | 8.537005 | 40 | |
| | 30 | 8.537359 | 611 | 8.537616 | 30 | |
| | 40 | 8.537969 | 610 | 8.538227 | 20 | |
| | 50 | 8.538578 | 609 | 8.538837 | 10 | |
| 59 | | 8.539186 | 608 | 8.539447 | | 1 |
| | 10 | 8.539794 | 608 | 8.540055 | 50 | |
| | 20 | 8.540401 | 607 | 8.540662 | 40 | |
| | 30 | 8.541007 | 606 | 8.541269 | 30 | |
| | 40 | 8.541612 | 605 | 8.541875 | 20 | |
| | 50 | 8.542216 | 604 | 8.542480 | 10 | |
| 60 | | 8.542819 | 603 | 8.543084 | | 0 |
| M | S | Co-sine. | Diff. | Co-tan. | S | M |

88 Degrees.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

0 Degree.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000000 | | 10.000000 | | 0.000000 | | Infinite. | 10.000000 | Infinite. | 60 |
| 1 | 6.463726 | 501717 | 10.000000 | 00 | 6.463726 | 501717 | 13.536274 | 10.000000 | 13.536274 | 59 |
| 2 | 6.764756 | 293485 | 10.000000 | 00 | 6.764756 | 293485 | 13.235244 | 10.000000 | 13.235244 | 58 |
| 3 | 6.940847 | 208231 | 10.000000 | 00 | 6.940847 | 208231 | 13.059153 | 10.000000 | 13.059153 | 57 |
| 4 | 7.065786 | 161517 | 10.000000 | 00 | 7.065786 | 161517 | 12.934214 | 10.000000 | 12.934214 | 56 |
| 5 | 7.162696 | 131968 | 10.000000 | 00 | 7.162696 | 131969 | 12.837304 | 10.000000 | 12.837304 | 55 |
| 6 | 7.241877 | 111578 | 9.999999 | 00 | 7.241878 | 111578 | 12.758122 | 10.000001 | 12.758123 | 54 |
| 7 | 7.308824 | 96653 | 9.999999 | 00 | 7.308825 | 96653 | 12.691175 | 10.000001 | 12.691176 | 53 |
| 8 | 7.366816 | 85254 | 9.999999 | 00 | 7.366817 | 85254 | 12.633183 | 10.000001 | 12.633184 | 52 |
| 9 | 7.417968 | 76262 | 9.999999 | 00 | 7.417970 | 76263 | 12.582030 | 10.000001 | 12.582032 | 51 |
| 10 | 7.463726 | 68988 | 9.999998 | 00 | 7.463727 | 68988 | 12.536273 | 10.000002 | 12.536274 | 50 |
| 11 | 7.505118 | 62981 | 9.999998 | 01 | 7.505120 | 62981 | 12.494880 | 10.000002 | 12.494882 | 49 |
| 12 | 7.542906 | 57936 | 9.999997 | 00 | 7.542909 | 57937 | 12.457091 | 10.000003 | 12.457094 | 48 |
| 13 | 7.577668 | 53641 | 9.999997 | 01 | 7.577672 | 53642 | 12.422328 | 10.000003 | 12.422332 | 47 |
| 14 | 7.609853 | 49938 | 9.999996 | 00 | 7.609857 | 49939 | 12.390143 | 10.000004 | 12.390147 | 46 |
| 15 | 7.639816 | 46714 | 9.999996 | 01 | 7.639820 | 46715 | 12.360180 | 10.000004 | 12.360184 | 45 |
| 16 | 7.667845 | 43881 | 9.999995 | 00 | 7.667849 | 43882 | 12.332151 | 10.000005 | 12.332155 | 44 |
| 17 | 7.694173 | 41372 | 9.999995 | 01 | 7.694179 | 41373 | 12.305821 | 10.000005 | 12.305827 | 43 |
| 18 | 7.718997 | 39135 | 9.999994 | 01 | 7.719003 | 39136 | 12.280997 | 10.000006 | 12.281003 | 42 |
| 19 | 7.742478 | 37127 | 9.999993 | 00 | 7.742484 | 37128 | 12.257516 | 10.000007 | 12.257522 | 41 |
| 20 | 7.764754 | 35315 | 9.999993 | 01 | 7.764761 | 35315 | 12.235239 | 10.000007 | 12.235246 | 40 |
| 21 | 7.785943 | 33672 | 9.999992 | 01 | 7.785951 | 33673 | 12.214049 | 10.000008 | 12.214057 | 39 |
| 22 | 7.806146 | 32175 | 9.999991 | 01 | 7.806155 | 32176 | 12.193845 | 10.000009 | 12.193854 | 38 |
| 23 | 7.825451 | 30805 | 9.999990 | 01 | 7.825460 | 30807 | 12.174540 | 10.000010 | 12.174549 | 37 |
| 24 | 7.843934 | 29547 | 9.999989 | 01 | 7.843944 | 29549 | 12.156056 | 10.000011 | 12.156066 | 36 |
| 25 | 7.861662 | 28388 | 9.999989 | 00 | 7.861674 | 28390 | 12.138326 | 10.000011 | 12.138338 | 35 |
| 26 | 7.878695 | 27317 | 9.999988 | 01 | 7.878708 | 27318 | 12.121292 | 10.000012 | 12.121305 | 34 |
| 27 | 7.895085 | 26323 | 9.999987 | 01 | 7.895099 | 26325 | 12.104901 | 10.000013 | 12.104915 | 33 |
| 28 | 7.910879 | 25399 | 9.999986 | 01 | 7.910894 | 25401 | 12.089106 | 10.000014 | 12.089121 | 32 |
| 29 | 7.926119 | 24538 | 9.999985 | 01 | 7.926134 | 24540 | 12.073866 | 10.000015 | 12.073881 | 31 |
| 30 | 7.940842 | 23733 | 9.999983 | 03 | 7.940858 | 23735 | 12.059142 | 10.000017 | 12.059158 | 30 |
| 31 | 7.955082 | 22980 | 9.999982 | 01 | 7.955100 | 22982 | 12.044900 | 10.000018 | 12.044918 | 29 |
| 32 | 7.968870 | 22273 | 9.999981 | 01 | 7.968889 | 22275 | 12.031111 | 10.000019 | 12.031130 | 28 |
| 33 | 7.982233 | 21608 | 9.999980 | 01 | 7.982253 | 21610 | 12.017747 | 10.000020 | 12.017767 | 27 |
| 34 | 7.995198 | 20981 | 9.999979 | 03 | 7.995219 | 20983 | 12.004781 | 10.000021 | 12.004802 | 26 |
| 35 | 8.007787 | 20390 | 9.999977 | 01 | 8.007809 | 20392 | 11.992191 | 10.000023 | 11.992213 | 25 |
| 36 | 8.020021 | 19831 | 9.999976 | 01 | 8.020045 | 19833 | 11.979955 | 10.000024 | 11.979979 | 24 |
| 37 | 8.031919 | 19302 | 9.999975 | 01 | 8.031945 | 19305 | 11.968055 | 10.000025 | 11.968081 | 23 |
| 38 | 8.043501 | 18801 | 9.999973 | 03 | 8.043527 | 18803 | 11.956473 | 10.000027 | 11.956499 | 22 |
| 39 | 8.054781 | 18325 | 9.999972 | 01 | 8.054809 | 18327 | 11.945191 | 10.000028 | 11.945219 | 21 |
| 40 | 8.065776 | 17872 | 9.999971 | 03 | 8.065806 | 17875 | 11.934194 | 10.000029 | 11.934224 | 20 |
| 41 | 8.076500 | 17441 | 9.999969 | 01 | 8.076531 | 17444 | 11.923469 | 10.000031 | 11.923500 | 19 |
| 42 | 8.086965 | 17031 | 9.999968 | 03 | 8.086997 | 17034 | 11.913003 | 10.000032 | 11.913035 | 18 |
| 43 | 8.097183 | 16639 | 9.999966 | 03 | 8.097217 | 16642 | 11.902783 | 10.000034 | 11.902817 | 17 |
| 44 | 8.107167 | 16265 | 9.999964 | 01 | 8.107202 | 16268 | 11.892798 | 10.000036 | 11.892833 | 16 |
| 45 | 8.116926 | 15908 | 9.999963 | 03 | 8.116963 | 15911 | 11.883037 | 10.000037 | 11.883074 | 15 |
| 46 | 8.126471 | 15566 | 9.999961 | 03 | 8.126510 | 15568 | 11.873490 | 10.000039 | 11.873529 | 14 |
| 47 | 8.135810 | 15238 | 9.999959 | 01 | 8.135851 | 15241 | 11.864149 | 10.000041 | 11.864190 | 13 |
| 48 | 8.144953 | 14924 | 9.999958 | 03 | 8.144996 | 14927 | 11.855004 | 10.000042 | 11.855047 | 12 |
| 49 | 8.153907 | 14622 | 9.999956 | 03 | 8.153952 | 14625 | 11.846048 | 10.000044 | 11.846093 | 11 |
| 50 | 8.162681 | 14333 | 9.999954 | 03 | 8.162727 | 14336 | 11.837273 | 10.000046 | 11.837319 | 10 |
| 51 | 8.171280 | 14054 | 9.999952 | 03 | 8.171328 | 14057 | 11.828672 | 10.000048 | 11.828720 | 9 |
| 52 | 8.179713 | 13786 | 9.999950 | 03 | 8.179763 | 13790 | 11.820237 | 10.000050 | 11.820287 | 8 |
| 53 | 8.187985 | 13529 | 9.999948 | 03 | 8.188036 | 13532 | 11.811964 | 10.000052 | 11.812015 | 7 |
| 54 | 8.196102 | 13280 | 9.999946 | 03 | 8.196156 | 13284 | 11.803844 | 10.000054 | 11.803898 | 6 |
| 55 | 8.204070 | 13041 | 9.999944 | 03 | 8.204126 | 13044 | 11.795874 | 10.000056 | 11.795930 | 5 |
| 56 | 8.211895 | 12810 | 9.999942 | 03 | 8.211953 | 12814 | 11.788047 | 10.000058 | 11.788105 | 4 |
| 57 | 8.219581 | 12587 | 9.999940 | 03 | 8.219641 | 12591 | 11.780359 | 10.000060 | 11.780419 | 3 |
| 58 | 8.227134 | 12372 | 9.999938 | 03 | 8.227195 | 12376 | 11.772805 | 10.000062 | 11.772866 | 2 |
| 59 | 8.234557 | 12164 | 9.999936 | 03 | 8.234621 | 12168 | 11.765379 | 10.000064 | 11.765443 | 1 |
| 60 | 8.241855 | | 9.999934 | | 8.241922 | | 11.758078 | 10.000066 | 11.758145 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

89 Degrees.

## 1 Degree.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.241855 | 11963 | 9.999934 | 03 | 8.241921 | 11967 | 11.758079 | 10.000066 | 11.758145 | 60 |
| 1 | 8.249033 | 11768 | 9.999932 | 05 | 8.249102 | 11772 | 11.750898 | 10.000068 | 11.750967 | 59 |
| 2 | 8.256094 | 11580 | 9.999929 | 03 | 8.256165 | 11584 | 11.743835 | 10.000071 | 11.743906 | 58 |
| 3 | 8.263042 | 11397 | 9.999927 | 03 | 8.263115 | 11402 | 11.736885 | 10.000073 | 11.736958 | 57 |
| 4 | 8.269881 | 11221 | 9.999925 | 05 | 8.269956 | 11225 | 11.730044 | 10.000075 | 11.730119 | 56 |
| 5 | 8.276614 | 11050 | 9.999922 | 03 | 8.276691 | 11054 | 11.723309 | 10.000078 | 11.723386 | 55 |
| 6 | 8.283243 | 10883 | 9.999920 | 05 | 8.283323 | 10887 | 11.716677 | 10.000080 | 11.716757 | 54 |
| 7 | 8.289773 | 10722 | 9.999918 | 03 | 8.289856 | 10726 | 11.710144 | 10.000082 | 11.710227 | 53 |
| 8 | 8.296207 | 10565 | 9.999915 | 05 | 8.296292 | 10570 | 11.703708 | 10.000085 | 11.703793 | 52 |
| 9 | 8.302546 | 10413 | 9.999913 | 03 | 8.302634 | 10418 | 11.697366 | 10.000087 | 11.697454 | 51 |
| 10 | 8.308794 | 10266 | 9.999910 | 05 | 8.308884 | 10270 | 11.691116 | 10.000090 | 11.691206 | 50 |
| 11 | 8.314954 | 10122 | 9.999907 | 03 | 8.315046 | 10126 | 11.684954 | 10.000093 | 11.685046 | 49 |
| 12 | 8.321027 | 9982 | 9.999905 | 05 | 8.321122 | 9987 | 11.678878 | 10.000095 | 11.678973 | 48 |
| 13 | 8.327016 | 9847 | 9.999902 | 05 | 8.327114 | 9851 | 11.672886 | 10.000098 | 11.672984 | 47 |
| 14 | 8.332924 | 9714 | 9.999899 | 03 | 8.333025 | 9719 | 11.666975 | 10.000101 | 11.667076 | 46 |
| 15 | 8.338753 | 9586 | 9.999897 | 05 | 8.338856 | 9590 | 11.661144 | 10.000103 | 11.661247 | 45 |
| 16 | 8.344504 | 9460 | 9.999894 | 05 | 8.344610 | 9465 | 11.655390 | 10.000106 | 11.655496 | 44 |
| 17 | 8.350181 | 9338 | 9.999891 | 05 | 8.350289 | 9343 | 11.649711 | 10.000109 | 11.649819 | 43 |
| 18 | 8.355783 | 9219 | 9.999888 | 05 | 8.355895 | 9224 | 11.644105 | 10.000112 | 11.644217 | 42 |
| 19 | 8.361315 | 9103 | 9.999885 | 05 | 8.361430 | 9108 | 11.638570 | 10.000115 | 11.638685 | 41 |
| 20 | 8.366777 | 8990 | 9.999882 | 05 | 8.366895 | 8995 | 11.633105 | 10.000118 | 11.633223 | 40 |
| 21 | 8.372171 | 8880 | 9.999879 | 05 | 8.372292 | 8885 | 11.627708 | 10.000121 | 11.627829 | 39 |
| 22 | 8.377499 | 8772 | 9.999876 | 05 | 8.377622 | 8777 | 11.622378 | 10.000124 | 11.622501 | 38 |
| 23 | 8.382762 | 8667 | 9.999873 | 05 | 8.382889 | 8672 | 11.617111 | 10.000127 | 11.617238 | 37 |
| 24 | 8.387962 | 8564 | 9.999870 | 05 | 8.388092 | 8570 | 11.611908 | 10.000130 | 11.612038 | 36 |
| 25 | 8.393101 | 8464 | 9.999867 | 05 | 8.393234 | 8470 | 11.606766 | 10.000133 | 11.606899 | 35 |
| 26 | 8.398179 | 8366 | 9.999864 | 05 | 8.398315 | 8371 | 11.601685 | 10.000136 | 11.601821 | 34 |
| 27 | 8.403199 | 8271 | 9.999861 | 05 | 8.403338 | 8276 | 11.596662 | 10.000139 | 11.596801 | 33 |
| 28 | 8.408161 | 8177 | 9.999858 | 07 | 8.408304 | 8182 | 11.591696 | 10.000142 | 11.591839 | 32 |
| 29 | 8.413068 | 8086 | 9.999854 | 05 | 8.413213 | 8091 | 11.586787 | 10.000146 | 11.586932 | 31 |
| 30 | 8.417919 | 7996 | 9.999851 | 05 | 8.418068 | 8002 | 11.581932 | 10.000149 | 11.582081 | 30 |
| 31 | 8.422717 | 7909 | 9.999848 | 07 | 8.422869 | 7914 | 11.577131 | 10.000152 | 11.577283 | 29 |
| 32 | 8.427462 | 7823 | 9.999844 | 05 | 8.427618 | 7829 | 11.572382 | 10.000156 | 11.572538 | 28 |
| 33 | 8.432156 | 7740 | 9.999841 | 05 | 8.432315 | 7745 | 11.567685 | 10.000159 | 11.567844 | 27 |
| 34 | 8.436800 | 7657 | 9.999838 | 07 | 8.436962 | 7663 | 11.563038 | 10.000162 | 11.563200 | 26 |
| 35 | 8.441394 | 7577 | 9.999834 | 05 | 8.441560 | 7583 | 11.558440 | 10.000166 | 11.558606 | 25 |
| 36 | 8.445941 | 7499 | 9.999831 | 07 | 8.446110 | 7505 | 11.553890 | 10.000169 | 11.554059 | 24 |
| 37 | 8.450440 | 7422 | 9.999827 | 07 | 8.450613 | 7428 | 11.549387 | 10.000173 | 11.549560 | 23 |
| 38 | 8.454893 | 7346 | 9.999824 | 05 | 8.455070 | 7352 | 11.544930 | 10.000176 | 11.545107 | 22 |
| 39 | 8.459301 | 7273 | 9.999820 | 07 | 8.459481 | 7279 | 11.540519 | 10.000180 | 11.540699 | 21 |
| 40 | 8.463665 | 7200 | 9.999816 | 07 | 8.463849 | 7206 | 11.536151 | 10.000184 | 11.536335 | 20 |
| 41 | 8.467985 | 7129 | 9.999813 | 05 | 8.468172 | 7135 | 11.531828 | 10.000187 | 11.532015 | 19 |
| 42 | 8.472263 | 7060 | 9.999809 | 07 | 8.472454 | 7066 | 11.527546 | 10.000191 | 11.527737 | 18 |
| 43 | 8.476498 | 6991 | 9.999805 | 07 | 8.476693 | 6998 | 11.523307 | 10.000195 | 11.523502 | 17 |
| 44 | 8.480693 | 6924 | 9.999801 | 07 | 8.480892 | 6931 | 11.519108 | 10.000199 | 11.519307 | 16 |
| 45 | 8.484848 | 6859 | 9.999797 | 07 | 8.485050 | 6865 | 11.514950 | 10.000203 | 11.515152 | 15 |
| 46 | 8.488963 | 6794 | 9.999794 | 05 | 8.489170 | 6801 | 11.510830 | 10.000206 | 11.511037 | 14 |
| 47 | 8.493040 | 6731 | 9.999790 | 07 | 8.493250 | 6738 | 11.506750 | 10.000210 | 11.506960 | 13 |
| 48 | 8.497078 | 6669 | 9.999786 | 07 | 8.497293 | 6676 | 11.502707 | 10.000214 | 11.502922 | 12 |
| 49 | 8.501080 | 6608 | 9.999782 | 07 | 8.501298 | 6615 | 11.498702 | 10.000218 | 11.498920 | 11 |
| 50 | 8.505045 | 6548 | 9.999778 | 07 | 8.505267 | 6555 | 11.494733 | 10.000222 | 11.494955 | 10 |
| 51 | 8.508974 | 6489 | 9.999774 | 08 | 8.509200 | 6496 | 11.490800 | 10.000226 | 11.491026 | 9 |
| 52 | 8.512867 | 6432 | 9.999769 | 07 | 8.513098 | 6439 | 11.486902 | 10.000231 | 11.487133 | 8 |
| 53 | 8.516726 | 6375 | 9.999765 | 07 | 8.516961 | 6382 | 11.483039 | 10.000235 | 11.483274 | 7 |
| 54 | 8.520551 | 6319 | 9.999761 | 07 | 8.520790 | 6326 | 11.479210 | 10.000239 | 11.479449 | 6 |
| 55 | 8.524343 | 6264 | 9.999757 | 07 | 8.524586 | 6272 | 11.475414 | 10.000243 | 11.475657 | 5 |
| 56 | 8.528102 | 6211 | 9.999753 | 08 | 8.528349 | 6218 | 11.471651 | 10.000247 | 11.471898 | 4 |
| 57 | 8.531828 | 6158 | 9.999748 | 07 | 8.532080 | 6165 | 11.467920 | 10.000252 | 11.468172 | 3 |
| 58 | 8.535523 | 6106 | 9.999744 | 07 | 8.535779 | 6113 | 11.464221 | 10.000256 | 11.464477 | 2 |
| 59 | 8.539186 | 6055 | 9.999740 | 08 | 8.539447 | 6062 | 11.460553 | 10.000260 | 11.460814 | 1 |
| 60 | 8.542819 | | 9.999735 | | 8.543084 | | 11.456916 | 10.000265 | 11.457181 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 2 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.542819 | 6004 | 9.999735 | 07 | 8.543084 | 6012 | 11.456916 | 10.000265 | 11.457181 | 60 |
| 1 | 8.546422 | 5955 | 9.999731 | 07 | 8.546691 | 5962 | 11.453309 | 10.000269 | 11.453578 | 59 |
| 2 | 8.549995 | 5906 | 9.999726 | 08 | 8.550268 | 5914 | 11.449732 | 10.000274 | 11.450005 | 58 |
| 3 | 8.553539 | 5858 | 9.999722 | 08 | 8.553817 | 5866 | 11.446188 | 10.000278 | 11.446461 | 57 |
| 4 | 8.557054 | 5811 | 9.999717 | 07 | 8.557336 | 5819 | 11.442664 | 10.000283 | 11.442946 | 56 |
| 5 | 8.560540 | 5765 | 9.999713 | 08 | 8.560828 | 5773 | 11.439172 | 10.000287 | 11.439460 | 55 |
| 6 | 8.563999 | 5719 | 9.999708 | 07 | 8.564291 | 5727 | 11.435709 | 10.000292 | 11.436001 | 54 |
| 7 | 8.567431 | 5674 | 9.999704 | 08 | 8.567727 | 5682 | 11.432273 | 10.000296 | 11.432569 | 53 |
| 8 | 8.570836 | 5630 | 9.999699 | 08 | 8.571137 | 5638 | 11.428863 | 10.000301 | 11.429164 | 52 |
| 9 | 8.574214 | 5587 | 9.999694 | 08 | 8.574520 | 5595 | 11.425480 | 10.000306 | 11.425786 | 51 |
| 10 | 8.577566 | 5544 | 9.999689 | 07 | 8.577877 | 5552 | 11.422123 | 10.000311 | 11.422434 | 50 |
| 11 | 8.580892 | 5502 | 9.999685 | 08 | 8.581208 | 5510 | 11.418792 | 10.000315 | 11.419108 | 49 |
| 12 | 8.584193 | 5460 | 9.999680 | 08 | 8.584514 | 5468 | 11.415486 | 10.000320 | 11.415807 | 48 |
| 13 | 8.587469 | 5419 | 9.999675 | 08 | 8.587795 | 5427 | 11.412205 | 10.000325 | 11.412531 | 47 |
| 14 | 8.590721 | 5379 | 9.999670 | 08 | 8.591051 | 5387 | 11.408949 | 10.000330 | 11.409279 | 46 |
| 15 | 8.593948 | 5339 | 9.999665 | 08 | 8.594283 | 5347 | 11.405717 | 10.000335 | 11.406052 | 45 |
| 16 | 8.597152 | 5300 | 9.999660 | 08 | 8.597492 | 5308 | 11.402508 | 10.000340 | 11.402848 | 44 |
| 17 | 8.600332 | 5261 | 9.999655 | 08 | 8.600677 | 5270 | 11.399323 | 10.000345 | 11.399668 | 43 |
| 18 | 8.603489 | 5223 | 9.999650 | 08 | 8.603839 | 5232 | 11.396161 | 10.000350 | 11.396511 | 42 |
| 19 | 8.606623 | 5186 | 9.999645 | 08 | 8.606978 | 5194 | 11.393022 | 10.000355 | 11.393377 | 41 |
| 20 | 8.609734 | 5149 | 9.999640 | 08 | 8.610094 | 5158 | 11.389906 | 10.000360 | 11.390266 | 40 |
| 21 | 8.612823 | 5112 | 9.999635 | 10 | 8.613189 | 5121 | 11.386811 | 10.000365 | 11.387177 | 39 |
| 22 | 8.615891 | 5076 | 9.999629 | 08 | 8.616262 | 5085 | 11.383738 | 10.000371 | 11.384109 | 38 |
| 23 | 8.618937 | 5041 | 9.999624 | 08 | 8.619313 | 5050 | 11.380687 | 10.000376 | 11.381063 | 37 |
| 24 | 8.621962 | 5006 | 9.999619 | 08 | 8.622343 | 5015 | 11.377657 | 10.000381 | 11.378038 | 36 |
| 25 | 8.624965 | 4972 | 9.999614 | 10 | 8.625352 | 4981 | 11.374648 | 10.000386 | 11.375035 | 35 |
| 26 | 8.627948 | 4938 | 9.999608 | 08 | 8.628340 | 4947 | 11.371660 | 10.000392 | 11.372052 | 34 |
| 27 | 8.630911 | 4904 | 9.999603 | 10 | 8.631308 | 4913 | 11.368692 | 10.000397 | 11.369089 | 33 |
| 28 | 8.633854 | 4871 | 9.999597 | 08 | 8.634256 | 4880 | 11.365744 | 10.000403 | 11.366146 | 32 |
| 29 | 8.636776 | 4839 | 9.999592 | 08 | 8.637184 | 4848 | 11.362816 | 10.000408 | 11.363224 | 31 |
| 30 | 8.639680 | 4806 | 9.999586 | 10 | 8.640093 | 4816 | 11.359907 | 10.000414 | 11.360320 | 30 |
| 31 | 8.642563 | 4775 | 9.999581 | 10 | 8.642982 | 4784 | 11.357018 | 10.000419 | 11.357437 | 29 |
| 32 | 8.645428 | 4743 | 9.999575 | 08 | 8.645853 | 4753 | 11.354147 | 10.000425 | 11.354572 | 28 |
| 33 | 8.648274 | 4712 | 9.999570 | 10 | 8.648704 | 4722 | 11.351296 | 10.000430 | 11.351726 | 27 |
| 34 | 8.651102 | 4682 | 9.999564 | 10 | 8.651537 | 4691 | 11.348463 | 10.000436 | 11.348898 | 26 |
| 35 | 8.653911 | 4652 | 9.999558 | 08 | 8.654352 | 4661 | 11.345648 | 10.000442 | 11.346089 | 25 |
| 36 | 8.656702 | 4622 | 9.999553 | 10 | 8.657149 | 4631 | 11.342851 | 10.000447 | 11.343296 | 24 |
| 37 | 8.659475 | 4592 | 9.999547 | 10 | 8.659928 | 4602 | 11.340072 | 10.000453 | 11.340525 | 23 |
| 38 | 8.662230 | 4563 | 9.999541 | 10 | 8.662689 | 4573 | 11.337311 | 10.000459 | 11.337770 | 22 |
| 39 | 8.664968 | 4535 | 9.999535 | 10 | 8.665433 | 4544 | 11.334567 | 10.000465 | 11.335032 | 21 |
| 40 | 8.667689 | 4506 | 9.999529 | 08 | 8.668160 | 4516 | 11.331840 | 10.000471 | 11.332311 | 20 |
| 41 | 8.670393 | 4479 | 9.999524 | 10 | 8.670870 | 4488 | 11.329130 | 10.000476 | 11.329607 | 19 |
| 42 | 8.673080 | 4451 | 9.999518 | 10 | 8.673563 | 4461 | 11.326437 | 10.000482 | 11.326920 | 18 |
| 43 | 8.675751 | 4424 | 9.999512 | 10 | 8.676239 | 4434 | 11.323761 | 10.000488 | 11.324249 | 17 |
| 44 | 8.678405 | 4397 | 9.999506 | 10 | 8.678900 | 4407 | 11.321100 | 10.000494 | 11.321595 | 16 |
| 45 | 8.681043 | 4370 | 9.999500 | 10 | 8.681544 | 4380 | 11.318456 | 10.000500 | 11.318957 | 15 |
| 46 | 8.683665 | 4344 | 9.999493 | 12 | 8.684172 | 4354 | 11.315828 | 10.000507 | 11.316335 | 14 |
| 47 | 8.686272 | 4318 | 9.999487 | 10 | 8.686784 | 4328 | 11.313216 | 10.000513 | 11.313728 | 13 |
| 48 | 8.688863 | 4292 | 9.999481 | 10 | 8.689381 | 4303 | 11.310619 | 10.000519 | 11.311137 | 12 |
| 49 | 8.691438 | 4267 | 9.999475 | 10 | 8.691963 | 4277 | 11.308037 | 10.000525 | 11.308562 | 11 |
| 50 | 8.693998 | 4242 | 9.999469 | 12 | 8.694529 | 4252 | 11.305471 | 10.000531 | 11.306002 | 10 |
| 51 | 8.696543 | 4217 | 9.999463 | 10 | 8.697081 | 4228 | 11.302919 | 10.000537 | 11.303457 | 9 |
| 52 | 8.699073 | 4192 | 9.999456 | 10 | 8.699617 | 4203 | 11.300383 | 10.000544 | 11.300927 | 8 |
| 53 | 8.701589 | 4168 | 9.999450 | 10 | 8.702139 | 4179 | 11.297861 | 10.000550 | 11.298411 | 7 |
| 54 | 8.704090 | 4144 | 9.999443 | 12 | 8.704646 | 4155 | 11.295354 | 10.000557 | 11.295910 | 6 |
| 55 | 8.706577 | 4121 | 9.999437 | 10 | 8.707140 | 4132 | 11.292860 | 10.000563 | 11.293423 | 5 |
| 56 | 8.709049 | 4097 | 9.999431 | 12 | 8.709618 | 4108 | 11.290382 | 10.000569 | 11.290951 | 4 |
| 57 | 8.711507 | 4074 | 9.999424 | 10 | 8.712083 | 4085 | 11.287917 | 10.000576 | 11.288493 | 3 |
| 58 | 8.713952 | 4052 | 9.999418 | 12 | 8.714534 | 4062 | 11.285466 | 10.000582 | 11.286048 | 2 |
| 59 | 8.716383 | 4029 | 9.999411 | 12 | 8.716972 | 4040 | 11.283028 | 10.000589 | 11.283617 | 1 |
| 60 | 8.718800 | | 9.999404 | | 8.719396 | | 11.280604 | 10.000596 | 11.281200 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 87 Degrees.

3 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.718800 | 4006 | 9.999404 | 10 | 8.719396 | 4017 | 11.280604 | 10.000596 | 11.281200 | 60 |
| 1 | 8.721204 | 3984 | 9.999398 | 12 | 8.721806 | 3995 | 11.278194 | 10.000602 | 11.278796 | 59 |
| 2 | 8.723595 | 3962 | 9.999391 | 12 | 8.724204 | 3974 | 11.275796 | 10.000609 | 11.276405 | 58 |
| 3 | 8.725972 | 3941 | 9.999384 | 10 | 8.726588 | 3952 | 11.273412 | 10.000616 | 11.274028 | 57 |
| 4 | 8.728337 | 3919 | 9.999378 | 12 | 8.728959 | 3931 | 11.271041 | 10.000622 | 11.271663 | 56 |
| 5 | 8.730688 | 3898 | 9.999371 | 12 | 8.731317 | 3909 | 11.268683 | 10.000629 | 11.269312 | 55 |
| 6 | 8.733027 | 3877 | 9.999364 | 12 | 8.733663 | 3889 | 11.266337 | 10.000636 | 11.266973 | 54 |
| 7 | 8.735354 | 3857 | 9.999357 | 12 | 8.735996 | 3868 | 11.264004 | 10.000643 | 11.264646 | 53 |
| 8 | 8.737667 | 3836 | 9.999350 | 12 | 8.738317 | 3848 | 11.261683 | 10.000650 | 11.262333 | 52 |
| 9 | 8.739969 | 3816 | 9.999343 | 12 | 8.740626 | 3827 | 11.259374 | 10.000657 | 11.260031 | 51 |
| 10 | 8.742259 | 3796 | 9.999336 | 12 | 8.742922 | 3807 | 11.257078 | 10.000664 | 11.257741 | 50 |
| 11 | 8.744536 | 3776 | 9.999329 | 12 | 8.745207 | 3787 | 11.254793 | 10.000671 | 11.255464 | 49 |
| 12 | 8.746802 | 3756 | 9.999322 | 12 | 8.747479 | 3768 | 11.252521 | 10.000678 | 11.253198 | 48 |
| 13 | 8.749055 | 3737 | 9.999315 | 12 | 8.749740 | 3749 | 11.250260 | 10.000685 | 11.250945 | 47 |
| 14 | 8.751297 | 3717 | 9.999308 | 12 | 8.751989 | 3729 | 11.248011 | 10.000692 | 11.248703 | 46 |
| 15 | 8.753528 | 3698 | 9.999301 | 12 | 8.754227 | 3710 | 11.245773 | 10.000699 | 11.246472 | 45 |
| 16 | 8.755747 | 3679 | 9.999294 | 13 | 8.756453 | 3692 | 11.243547 | 10.000706 | 11.244253 | 44 |
| 17 | 8.757955 | 3661 | 9.999287 | 12 | 8.758668 | 3673 | 11.241332 | 10.000713 | 11.242045 | 43 |
| 18 | 8.760151 | 3642 | 9.999279 | 12 | 8.760872 | 3655 | 11.239128 | 10.000721 | 11.239849 | 42 |
| 19 | 8.762337 | 3624 | 9.999272 | 12 | 8.763065 | 3636 | 11.236935 | 10.000728 | 11.237663 | 41 |
| 20 | 8.764511 | 3606 | 9.999265 | 13 | 8.765246 | 3618 | 11.234754 | 10.000735 | 11.235489 | 40 |
| 21 | 8.766675 | 3588 | 9.999257 | 12 | 8.767417 | 3600 | 11.232583 | 10.000743 | 11.233325 | 39 |
| 22 | 8.768828 | 3570 | 9.999250 | 13 | 8.769578 | 3583 | 11.230422 | 10.000750 | 11.231172 | 38 |
| 23 | 8.770970 | 3553 | 9.999242 | 12 | 8.771727 | 3565 | 11.228273 | 10.000758 | 11.229030 | 37 |
| 24 | 8.773101 | 3535 | 9.999235 | 13 | 8.773866 | 3548 | 11.226134 | 10.000765 | 11.226899 | 36 |
| 25 | 8.775223 | 3518 | 9.999227 | 12 | 8.775995 | 3531 | 11.224005 | 10.000773 | 11.224777 | 35 |
| 26 | 8.777333 | 3501 | 9.999220 | 13 | 8.778114 | 3514 | 11.221886 | 10.000780 | 11.222667 | 34 |
| 27 | 8.779434 | 3484 | 9.999212 | 13 | 8.780222 | 3497 | 11.219778 | 10.000788 | 11.220566 | 33 |
| 28 | 8.781524 | 3467 | 9.999205 | 13 | 8.782320 | 3480 | 11.217680 | 10.000795 | 11.218476 | 32 |
| 29 | 8.783605 | 3451 | 9.999197 | 13 | 8.784408 | 3464 | 11.215592 | 10.000803 | 11.216395 | 31 |
| 30 | 8.785675 | 3434 | 9.999189 | 13 | 8.786486 | 3447 | 11.213514 | 10.000811 | 11.214325 | 30 |
| 31 | 8.787736 | 3418 | 9.999181 | 12 | 8.788554 | 3431 | 11.211446 | 10.000819 | 11.212264 | 29 |
| 32 | 8.789787 | 3402 | 9.999174 | 13 | 8.790613 | 3415 | 11.209387 | 10.000826 | 11.210213 | 28 |
| 33 | 8.791828 | 3386 | 9.999166 | 13 | 8.792662 | 3399 | 11.207338 | 10.000834 | 11.208172 | 27 |
| 34 | 8.793859 | 3370 | 9.999158 | 13 | 8.794701 | 3383 | 11.205299 | 10.000842 | 11.206141 | 26 |
| 35 | 8.795881 | 3354 | 9.999150 | 13 | 8.796731 | 3368 | 11.203269 | 10.000850 | 11.204119 | 25 |
| 36 | 8.797894 | 3339 | 9.999142 | 13 | 8.798752 | 3352 | 11.201248 | 10.000858 | 11.202106 | 24 |
| 37 | 8.799897 | 3323 | 9.999134 | 13 | 8.800763 | 3337 | 11.199237 | 10.000866 | 11.200103 | 23 |
| 38 | 8.801892 | 3308 | 9.999126 | 13 | 8.802765 | 3322 | 11.197235 | 10.000874 | 11.198108 | 22 |
| 39 | 8.803876 | 3293 | 9.999118 | 13 | 8.804758 | 3306 | 11.195242 | 10.000882 | 11.196124 | 21 |
| 40 | 8.805852 | 3278 | 9.999110 | 13 | 8.806742 | 3292 | 11.193258 | 10.000890 | 11.194148 | 20 |
| 41 | 8.807819 | 3263 | 9.999102 | 13 | 8.808717 | 3277 | 11.191283 | 10.000898 | 11.192181 | 19 |
| 42 | 8.809777 | 3249 | 9.999094 | 13 | 8.810683 | 3262 | 11.189317 | 10.000906 | 11.190223 | 18 |
| 43 | 8.811726 | 3234 | 9.999086 | 15 | 8.812641 | 3248 | 11.187359 | 10.000914 | 11.188274 | 17 |
| 44 | 8.813667 | 3219 | 9.999077 | 13 | 8.814589 | 3233 | 11.185411 | 10.000923 | 11.186333 | 16 |
| 45 | 8.815599 | 3205 | 9.999069 | 13 | 8.816529 | 3219 | 11.183471 | 10.000931 | 11.184401 | 15 |
| 46 | 8.817522 | 3191 | 9.999061 | 15 | 8.818461 | 3205 | 11.181539 | 10.000939 | 11.182478 | 14 |
| 47 | 8.819436 | 3177 | 9.999053 | 13 | 8.820384 | 3191 | 11.179616 | 10.000947 | 11.180564 | 13 |
| 48 | 8.821343 | 3163 | 9.999044 | 13 | 8.822298 | 3177 | 11.177702 | 10.000956 | 11.178657 | 12 |
| 49 | 8.823240 | 3149 | 9.999036 | 15 | 8.824205 | 3163 | 11.175795 | 10.000964 | 11.176760 | 11 |
| 50 | 8.825130 | 3135 | 9.999027 | 13 | 8.826103 | 3150 | 11.173897 | 10.000973 | 11.174870 | 10 |
| 51 | 8.827011 | 3122 | 9.999019 | 15 | 8.827992 | 3136 | 11.172008 | 10.000981 | 11.172989 | 9 |
| 52 | 8.828884 | 3108 | 9.999010 | 13 | 8.829874 | 3123 | 11.170126 | 10.000990 | 11.171116 | 8 |
| 53 | 8.830749 | 3095 | 9.999002 | 15 | 8.831748 | 3109 | 11.168252 | 10.000998 | 11.169251 | 7 |
| 54 | 8.832607 | 3082 | 9.998993 | 15 | 8.833613 | 3096 | 11.166387 | 10.001007 | 11.167393 | 6 |
| 55 | 8.834456 | 3069 | 9.998984 | 13 | 8.835471 | 3083 | 11.164529 | 10.001016 | 11.165544 | 5 |
| 56 | 8.836297 | 3056 | 9.998976 | 15 | 8.837321 | 3070 | 11.162679 | 10.001024 | 11.163703 | 4 |
| 57 | 8.838130 | 3043 | 9.998967 | 15 | 8.839163 | 3057 | 11.160837 | 10.001033 | 11.161870 | 3 |
| 58 | 8.839956 | 3030 | 9.998958 | 13 | 8.840998 | 3045 | 11.159002 | 10.001042 | 11.160044 | 2 |
| 59 | 8.841774 | 3017 | 9.998950 | 15 | 8.842825 | 3032 | 11.157175 | 10.001050 | 11.158226 | 1 |
| 60 | 8.843585 | | 9.998941 | | 8.844644 | | 11.155356 | 10.001059 | 11.156415 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

4 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.843585 | 3005 | 9.998941 | 15 | 8.844644 | 3019 | 11.155356 | 10.001059 | 11.156415 | 60 |
| 1 | 8.845387 | 2992 | 9.998932 | 15 | 8.846455 | 3007 | 11.153545 | 10.001068 | 11.154613 | 59 |
| 2 | 8.847183 | 2980 | 9.998923 | 15 | 8.848260 | 2995 | 11.151740 | 10.001077 | 11.152817 | 58 |
| 3 | 8.848971 | 2967 | 9.998914 | 15 | 8.850057 | 2982 | 11.149943 | 10.001086 | 11.151029 | 57 |
| 4 | 8.850751 | 2955 | 9.998905 | 15 | 8.851846 | 2970 | 11.148154 | 10.001095 | 11.149249 | 56 |
| 5 | 8.852525 | 2943 | 9.998896 | 15 | 8.853628 | 2958 | 11.146372 | 10.001104 | 11.147475 | 55 |
| 6 | 8.854291 | 2931 | 9.998887 | 15 | 8.855403 | 2946 | 11.144597 | 10.001113 | 11.145709 | 54 |
| 7 | 8.856049 | 2919 | 9.998878 | 15 | 8.857171 | 2935 | 11.142829 | 10.001122 | 11.143951 | 53 |
| 8 | 8.857801 | 2908 | 9.998869 | 15 | 8.858932 | 2923 | 11.141068 | 10.001131 | 11.142199 | 52 |
| 9 | 8.859546 | 2896 | 9.998860 | 15 | 8.860686 | 2911 | 11.139314 | 10.001140 | 11.140454 | 51 |
| 10 | 8.861283 | 2884 | 9.998851 | 17 | 8.862433 | 2900 | 11.137567 | 10.001149 | 11.138717 | 50 |
| 11 | 8.863014 | 2873 | 9.998841 | 15 | 8.864173 | 2888 | 11.135827 | 10.001159 | 11.136986 | 49 |
| 12 | 8.864738 | 2861 | 9.998832 | 15 | 8.865906 | 2877 | 11.134094 | 10.001168 | 11.135262 | 48 |
| 13 | 8.866455 | 2850 | 9.998823 | 17 | 8.867632 | 2866 | 11.132368 | 10.001177 | 11.133545 | 47 |
| 14 | 8.868165 | 2839 | 9.998813 | 15 | 8.869351 | 2854 | 11.130649 | 10.001187 | 11.131835 | 46 |
| 15 | 8.869868 | 2828 | 9.998804 | 15 | 8.871064 | 2843 | 11.128936 | 10.001196 | 11.130132 | 45 |
| 16 | 8.871565 | 2817 | 9.998795 | 17 | 8.872770 | 2832 | 11.127230 | 10.001205 | 11.128435 | 44 |
| 17 | 8.873255 | 2806 | 9.998785 | 15 | 8.874469 | 2821 | 11.125531 | 10.001215 | 11.126745 | 43 |
| 18 | 8.874938 | 2795 | 9.998776 | 17 | 8.876162 | 2811 | 11.123838 | 10.001224 | 11.125062 | 42 |
| 19 | 8.876615 | 2784 | 9.998766 | 15 | 8.877849 | 2800 | 11.122151 | 10.001234 | 11.123385 | 41 |
| 20 | 8.878285 | 2773 | 9.998757 | 17 | 8.879529 | 2789 | 11.120471 | 10.001243 | 11.121715 | 40 |
| 21 | 8.879949 | 2763 | 9.998747 | 17 | 8.881202 | 2779 | 11.118798 | 10.001253 | 11.120051 | 39 |
| 22 | 8.881607 | 2752 | 9.998738 | 15 | 8.882869 | 2768 | 11.117131 | 10.001262 | 11.118393 | 38 |
| 23 | 8.883258 | 2742 | 9.998728 | 17 | 8.884530 | 2758 | 11.115470 | 10.001272 | 11.116742 | 37 |
| 24 | 8.884903 | 2731 | 9.998718 | 17 | 8.886185 | 2747 | 11.113815 | 10.001282 | 11.115097 | 36 |
| 25 | 8.886542 | 2721 | 9.998708 | 15 | 8.887833 | 2737 | 11.112167 | 10.001292 | 11.113458 | 35 |
| 26 | 8.888174 | 2711 | 9.998699 | 17 | 8.889476 | 2727 | 11.110524 | 10.001301 | 11.111826 | 34 |
| 27 | 8.889801 | 2700 | 9.998689 | 17 | 8.891112 | 2717 | 11.108888 | 10.001311 | 11.110199 | 33 |
| 28 | 8.891421 | 2690 | 9.998679 | 17 | 8.892742 | 2707 | 11.107258 | 10.001321 | 11.108579 | 32 |
| 29 | 8.893035 | 2680 | 9.998669 | 17 | 8.894366 | 2697 | 11.105634 | 10.001331 | 11.106965 | 31 |
| 30 | 8.894643 | 2670 | 9.998659 | 17 | 8.895984 | 2687 | 11.104016 | 10.001341 | 11.105357 | 30 |
| 31 | 8.896246 | 2660 | 9.998649 | 17 | 8.897596 | 2677 | 11.102404 | 10.001351 | 11.103754 | 29 |
| 32 | 8.897842 | 2651 | 9.998639 | 17 | 8.899203 | 2667 | 11.100797 | 10.001361 | 11.102158 | 28 |
| 33 | 8.899432 | 2641 | 9.998629 | 17 | 8.900803 | 2658 | 11.099197 | 10.001371 | 11.100568 | 27 |
| 34 | 8.901017 | 2631 | 9.998619 | 17 | 8.902398 | 2648 | 11.097602 | 10.001381 | 11.098983 | 26 |
| 35 | 8.902596 | 2622 | 9.998609 | 17 | 8.903987 | 2638 | 11.096013 | 10.001391 | 11.097404 | 25 |
| 36 | 8.904169 | 2612 | 9.998599 | 17 | 8.905570 | 2629 | 11.094430 | 10.001401 | 11.095831 | 24 |
| 37 | 8.905736 | 2603 | 9.998589 | 18 | 8.907147 | 2620 | 11.092853 | 10.001411 | 11.094264 | 23 |
| 38 | 8.907297 | 2593 | 9.998578 | 17 | 8.908719 | 2610 | 11.091281 | 10.001422 | 11.092703 | 22 |
| 39 | 8.908853 | 2584 | 9.998568 | 17 | 8.910285 | 2601 | 11.089715 | 10.001432 | 11.091147 | 21 |
| 40 | 8.910404 | 2575 | 9.998558 | 17 | 8.911846 | 2592 | 11.088154 | 10.001442 | 11.089596 | 20 |
| 41 | 8.911949 | 2566 | 9.998548 | 18 | 8.913401 | 2583 | 11.086599 | 10.001452 | 11.088051 | 19 |
| 42 | 8.913488 | 2556 | 9.998537 | 17 | 8.914951 | 2574 | 11.085049 | 10.001463 | 11.086512 | 18 |
| 43 | 8.915022 | 2547 | 9.998527 | 18 | 8.916495 | 2565 | 11.083505 | 10.001473 | 11.084978 | 17 |
| 44 | 8.916550 | 2538 | 9.998516 | 17 | 8.918034 | 2556 | 11.081966 | 10.001484 | 11.083450 | 16 |
| 45 | 8.918073 | 2529 | 9.998506 | 18 | 8.919568 | 2547 | 11.080432 | 10.001494 | 11.081927 | 15 |
| 46 | 8.919591 | 2520 | 9.998495 | 18 | 8.921096 | 2538 | 11.078904 | 10.001505 | 11.080409 | 14 |
| 47 | 8.921103 | 2512 | 9.998485 | 18 | 8.922619 | 2530 | 11.077381 | 10.001515 | 11.078897 | 13 |
| 48 | 8.922610 | 2503 | 9.998474 | 17 | 8.924136 | 2521 | 11.075864 | 10.001526 | 11.077390 | 12 |
| 49 | 8.924112 | 2494 | 9.998464 | 18 | 8.925649 | 2512 | 11.074351 | 10.001536 | 11.075888 | 11 |
| 50 | 8.925609 | 2486 | 9.998453 | 18 | 8.927156 | 2503 | 11.072844 | 10.001547 | 11.074391 | 10 |
| 51 | 8.927100 | 2477 | 9.998442 | 18 | 8.928658 | 2495 | 11.071342 | 10.001558 | 11.072900 | 9 |
| 52 | 8.928587 | 2469 | 9.998431 | 17 | 8.930155 | 2486 | 11.069845 | 10.001569 | 11.071413 | 8 |
| 53 | 8.930068 | 2460 | 9.998421 | 18 | 8.931647 | 2478 | 11.068353 | 10.001579 | 11.069932 | 7 |
| 54 | 8.931544 | 2452 | 9.998410 | 18 | 8.933134 | 2470 | 11.066866 | 10.001590 | 11.068456 | 6 |
| 55 | 8.933015 | 2443 | 9.998399 | 18 | 8.934616 | 2461 | 11.065384 | 10.001601 | 11.066985 | 5 |
| 56 | 8.934481 | 2435 | 9.998388 | 18 | 8.936093 | 2453 | 11.063907 | 10.001612 | 11.065519 | 4 |
| 57 | 8.935942 | 2427 | 9.998377 | 18 | 8.937565 | 2445 | 11.062435 | 10.001623 | 11.064058 | 3 |
| 58 | 8.937398 | 2419 | 9.998366 | 18 | 8.939032 | 2437 | 11.060968 | 10.001634 | 11.062602 | 2 |
| 59 | 8.938850 | 2411 | 9.998355 | 18 | 8.940494 | 2429 | 11.059506 | 10.001645 | 11.061150 | 1 |
| 60 | 8.940296 | | 9.998344 | | 8.941952 | | 11.058048 | 10.001656 | 11.059704 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

85 Degrees.

5 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.940296 | 2403 | 9.998344 | 18 | 8.941952 | 2421 | 11 058048 | 10.001656 | 11.059704 | 60 |
| 1 | 8.941738 | 2394 | 9.998333 | 18 | 8.943404 | 2413 | 11.056596 | 10.001667 | 11.058262 | 59 |
| 2 | 8.943174 | 2387 | 9.998322 | 18 | 8.944852 | 2405 | 11.055148 | 10.001678 | 11.056826 | 58 |
| 3 | 8.944606 | 2379 | 9.998311 | 18 | 8.946295 | 2397 | 11.053705 | 10.001689 | 11.055394 | 57 |
| 4 | 8.946034 | 2371 | 9.998300 | 18 | 8.947734 | 2390 | 11.052266 | 10.001700 | 11.053966 | 56 |
| 5 | 8.947456 | 2363 | 9.998289 | 20 | 8.949168 | 2382 | 11.050832 | 10.001711 | 11.052544 | 55 |
| 6 | 8.948874 | 2355 | 9.998277 | 18 | 8.950597 | 2374 | 11.049403 | 10.001723 | 11.051126 | 54 |
| 7 | 8.950287 | 2348 | 9.998266 | 18 | 8.952021 | 2366 | 11.047979 | 10.001734 | 11.049713 | 53 |
| 8 | 8.951696 | 2340 | 9.998255 | 20 | 8.953441 | 2359 | 11.046559 | 10.001745 | 11.048304 | 52 |
| 9 | 8.953100 | 2332 | 9.998243 | 18 | 8.954856 | 2351 | 11.045144 | 10.001757 | 11.046900 | 51 |
| 10 | 8.954499 | 2325 | 9.998232 | 20 | 8.956267 | 2344 | 11.043733 | 10.001768 | 11.045501 | 50 |
| 11 | 8.955894 | 2317 | 9.998220 | 18 | 8.957674 | 2336 | 11.042326 | 10.001780 | 11.044106 | 49 |
| 12 | 8.957284 | 2310 | 9.998209 | 20 | 8.959075 | 2329 | 11.040925 | 10.001791 | 11.042716 | 48 |
| 13 | 8.958670 | 2302 | 9.998197 | 18 | 8.960473 | 2322 | 11.039527 | 10.001803 | 11.041330 | 47 |
| 14 | 8.960052 | 2295 | 9.998186 | 20 | 8.961866 | 2314 | 11.038134 | 10.001814 | 11.039948 | 46 |
| 15 | 8.961429 | 2288 | 9.998174 | 18 | 8.963255 | 2307 | 11.036745 | 10.001826 | 11.038571 | 45 |
| 16 | 8.962801 | 2280 | 9.998163 | 20 | 8.964639 | 2300 | 11.035361 | 10.001837 | 11.037199 | 44 |
| 17 | 8.964170 | 2273 | 9.998151 | 20 | 8.966019 | 2293 | 11.033981 | 10.001849 | 11.035830 | 43 |
| 18 | 8.965534 | 2266 | 9.998139 | 18 | 8.967394 | 2286 | 11.032606 | 10.001861 | 11.034466 | 42 |
| 19 | 8.966893 | 2259 | 9.998128 | 20 | 8.968766 | 2279 | 11.031234 | 10.001872 | 11.033107 | 41 |
| 20 | 8.968249 | 2252 | 9.998116 | 20 | 8.970133 | 2271 | 11.029867 | 10.001884 | 11.031751 | 40 |
| 21 | 8.969600 | 2245 | 9.998104 | 20 | 8.971496 | 2265 | 11.028504 | 10.001896 | 11.030400 | 39 |
| 22 | 8.970947 | 2238 | 9.998092 | 20 | 8.972855 | 2257 | 11.027145 | 10.001908 | 11.029053 | 38 |
| 23 | 8.972289 | 2231 | 9.998080 | 20 | 8.974209 | 2251 | 11.025791 | 10.001920 | 11.027711 | 37 |
| 24 | 8.973628 | 2224 | 9.998068 | 20 | 8.975560 | 2244 | 11.024440 | 10.001932 | 11.026372 | 36 |
| 25 | 8.974962 | 2217 | 9.998056 | 20 | 8.976906 | 2237 | 11.023094 | 10.001944 | 11.025038 | 35 |
| 26 | 8.976293 | 2210 | 9.998044 | 20 | 8.978248 | 2230 | 11.021752 | 10.001956 | 11.023707 | 34 |
| 27 | 8.977619 | 2203 | 9.998032 | 20 | 8.979586 | 2223 | 11.020414 | 10.001968 | 11.022381 | 33 |
| 28 | 8.978941 | 2197 | 9.998020 | 20 | 8.980921 | 2217 | 11.019079 | 10.001980 | 11.021059 | 32 |
| 29 | 8.980259 | 2190 | 9.998008 | 20 | 8.982251 | 2210 | 11.017749 | 10.001992 | 11.019741 | 31 |
| 30 | 8.981573 | 2183 | 9.997996 | 20 | 8.983577 | 2204 | 11.016423 | 10.002004 | 11.018427 | 30 |
| 31 | 8.982883 | 2177 | 9.997984 | 20 | 8.984899 | 2197 | 11.015101 | 10.002016 | 11.017117 | 29 |
| 32 | 8.984189 | 2170 | 9.997972 | 22 | 8.986217 | 2191 | 11.013783 | 10.002028 | 11.015811 | 28 |
| 33 | 8.985491 | 2163 | 9.997959 | 20 | 8.987532 | 2184 | 11.012468 | 10.002041 | 11.014509 | 27 |
| 34 | 8.986789 | 2157 | 9.997947 | 20 | 8.988842 | 2178 | 11.011158 | 10.002053 | 11.013211 | 26 |
| 35 | 8.988083 | 2150 | 9.997935 | 22 | 8.990149 | 2171 | 11.009851 | 10.002065 | 11.011917 | 25 |
| 36 | 8.989374 | 2144 | 9.997922 | 20 | 8.991451 | 2165 | 11.008549 | 10.002078 | 11.010626 | 24 |
| 37 | 8.990660 | 2138 | 9.997910 | 22 | 8.992750 | 2158 | 11.007250 | 10.002090 | 11.009340 | 23 |
| 38 | 8.991943 | 2131 | 9.997897 | 20 | 8.994045 | 2152 | 11.005955 | 10.002103 | 11.008057 | 22 |
| 39 | 8.993222 | 2125 | 9.997885 | 22 | 8.995337 | 2146 | 11.004663 | 10.002115 | 11.006778 | 21 |
| 40 | 8.994497 | 2119 | 9.997872 | 20 | 8.996624 | 2140 | 11.003376 | 10.002128 | 11.005503 | 20 |
| 41 | 8.995768 | 2112 | 9.997860 | 22 | 8.997908 | 2134 | 11.002092 | 10.002140 | 11.004232 | 19 |
| 42 | 8.997036 | 2106 | 9.997847 | 20 | 8.999188 | 2127 | 11.000812 | 10.002153 | 11.002964 | 18 |
| 43 | 8.998299 | 2100 | 9.997835 | 22 | 9.000465 | 2121 | 10.999535 | 10.002165 | 11.001701 | 17 |
| 44 | 8.999560 | 2094 | 9.997822 | 22 | 9.001738 | 2115 | 10.998262 | 10.002178 | 11.000440 | 16 |
| 45 | 9.000816 | 2088 | 9.997809 | 20 | 9.003007 | 2109 | 10.996993 | 10.002191 | 10.999184 | 15 |
| 46 | 9.002069 | 2082 | 9.997797 | 22 | 9.004272 | 2103 | 10.995728 | 10.002203 | 10.997931 | 14 |
| 47 | 9.003318 | 2076 | 9.997784 | 22 | 9.005534 | 2097 | 10.994466 | 10.002216 | 10.996682 | 13 |
| 48 | 9.004563 | 2070 | 9.997771 | 22 | 9.006792 | 2091 | 10.993208 | 10.002229 | 10.995437 | 12 |
| 49 | 9.005805 | 2064 | 9.997758 | 22 | 9.008047 | 2085 | 10.991953 | 10.002242 | 10.994195 | 11 |
| 50 | 9.007044 | 2058 | 9.997745 | 22 | 9.009298 | 2079 | 10.990702 | 10.002255 | 10.992956 | 10 |
| 51 | 9.008278 | 2052 | 9.997732 | 22 | 9.010546 | 2074 | 10.989454 | 10.002268 | 10.991722 | 9 |
| 52 | 9.009510 | 2046 | 9.997719 | 22 | 9.011790 | 2068 | 10.988210 | 10.002281 | 10.990490 | 8 |
| 53 | 9.010737 | 2040 | 9.997706 | 22 | 9.013031 | 2062 | 10.986969 | 10.002294 | 10.989263 | 7 |
| 54 | 9.011962 | 2034 | 9.997693 | 22 | 9.014268 | 2056 | 10.985732 | 10.002307 | 10.988038 | 6 |
| 55 | 9.013182 | 2029 | 9.997680 | 22 | 9.015502 | 2051 | 10.984498 | 10.002320 | 10.986818 | 5 |
| 56 | 9.014400 | 2023 | 9.997667 | 22 | 9.016732 | 2045 | 10.983268 | 10.002333 | 10.985600 | 4 |
| 57 | 9.015613 | 2017 | 9.997654 | 22 | 9.017959 | 2039 | 10.982041 | 10.002346 | 10.984387 | 3 |
| 58 | 9.016824 | 2012 | 9.997641 | 22 | 9.019183 | 2034 | 10.980817 | 10.002359 | 10.983176 | 2 |
| 59 | 9.018031 | 2006 | 9.997628 | 22 | 9.020403 | 2028 | 10.979597 | 10.002372 | 10.981969 | 1 |
| 60 | 9.019235 | | 9.997614 | 23 | 9.021620 | | 10.978380 | 10.002386 | 10.980765 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

84 Degrees.

## 6 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.019235 | 2000 | 9.997614 | 22 | 9.021620 | 2023 | 10.978380 | 10.002386 | 10.980765 | 60 |
| 1 | 9.020435 | 1995 | 9.997601 | 22 | 9.022834 | 2017 | 10.977166 | 10.002399 | 10.979565 | 59 |
| 2 | 9.021632 | 1989 | 9.997588 | 23 | 9.024044 | 2011 | 10.975956 | 10.002412 | 10.978368 | 58 |
| 3 | 9.022825 | 1984 | 9.997574 | 22 | 9.025251 | 2006 | 10.974749 | 10.002426 | 10.977175 | 57 |
| 4 | 9.024016 | 1978 | 9.997561 | 23 | 9.026455 | 2001 | 10.973545 | 10.002439 | 10.975984 | 56 |
| 5 | 9.025203 | 1973 | 9.997547 | 23 | 9.027655 | 1995 | 10.972345 | 10.002453 | 10.974797 | 55 |
| 6 | 9.026386 | 1967 | 9.997534 | 23 | 9.028852 | 1990 | 10.971148 | 10.002466 | 10.973614 | 54 |
| 7 | 9.027567 | 1962 | 9.997520 | 22 | 9.030046 | 1985 | 10.969954 | 10.002480 | 10.972433 | 53 |
| 8 | 9.028744 | 1957 | 9.997507 | 23 | 9.031237 | 1979 | 10.968768 | 10.002493 | 10.971256 | 52 |
| 9 | 9.029918 | 1951 | 9.997493 | 22 | 9.032425 | 1974 | 10.967575 | 10.002507 | 10.970082 | 51 |
| 10 | 9.031089 | 1946 | 9.997480 | 23 | 9.033609 | 1969 | 10.966391 | 10.002520 | 10.968911 | 50 |
| 11 | 9.032257 | 1941 | 9.997466 | 23 | 9.034791 | 1964 | 10.965209 | 10.002534 | 10.967743 | 49 |
| 12 | 9.033421 | 1936 | 9.997452 | 22 | 9.035969 | 1958 | 10.964031 | 10.002548 | 10.966579 | 48 |
| 13 | 9.034582 | 1930 | 9.997439 | 23 | 9.037144 | 1953 | 10.962856 | 10.002561 | 10.965418 | 47 |
| 14 | 9.035741 | 1925 | 9.997425 | 23 | 9.038316 | 1948 | 10.961684 | 10.002575 | 10.964259 | 46 |
| 15 | 9.036896 | 1920 | 9.997411 | 23 | 9.039485 | 1943 | 10.960515 | 10.002589 | 10.963104 | 45 |
| 16 | 9.038048 | 1915 | 9.997397 | 23 | 9.040651 | 1938 | 10.959349 | 10.002603 | 10.961952 | 44 |
| 17 | 9.039197 | 1910 | 9.997383 | 23 | 9.041813 | 1933 | 10.958187 | 10.002617 | 10.960803 | 43 |
| 18 | 9.040342 | 1905 | 9.997369 | 23 | 9.042973 | 1928 | 10.957027 | 10.002631 | 10.959658 | 42 |
| 19 | 9.041485 | 1899 | 9.997355 | 23 | 9.044130 | 1923 | 10.955870 | 10.002645 | 10.958515 | 41 |
| 20 | 9.042625 | 1895 | 9.997341 | 23 | 9.045284 | 1918 | 10.954716 | 10.002659 | 10.957375 | 40 |
| 21 | 9.043762 | 1889 | 9.997327 | 23 | 9.046434 | 1913 | 10.953566 | 10.002673 | 10.956238 | 39 |
| 22 | 9.044895 | 1884 | 9.997313 | 23 | 9.047582 | 1908 | 10.952418 | 10.002687 | 10.955105 | 38 |
| 23 | 9.046026 | 1879 | 9.997299 | 23 | 9.048727 | 1903 | 10.951273 | 10.002701 | 10.953974 | 37 |
| 24 | 9.047154 | 1875 | 9.997285 | 23 | 9.049869 | 1898 | 10.950131 | 10.002715 | 10.952846 | 36 |
| 25 | 9.048279 | 1870 | 9.997271 | 23 | 9.051008 | 1893 | 10.948992 | 10.002729 | 10.951721 | 35 |
| 26 | 9.049400 | 1865 | 9.997257 | 25 | 9.052144 | 1889 | 10.947856 | 10.002743 | 10.950600 | 34 |
| 27 | 9.050519 | 1860 | 9.997242 | 23 | 9.053277 | 1884 | 10.946723 | 10.002758 | 10.949481 | 33 |
| 28 | 9.051635 | 1855 | 9.997228 | 23 | 9.054407 | 1879 | 10.945593 | 10.002772 | 10.948365 | 32 |
| 29 | 9.052749 | 1850 | 9.997214 | 23 | 9.055535 | 1874 | 10.944465 | 10.002786 | 10.947251 | 31 |
| 30 | 9.053859 | 1845 | 9.997199 | 25 | 9.056659 | 1870 | 10.943341 | 10.002801 | 10.946141 | 30 |
| 31 | 9.054966 | 1841 | 9.997185 | 23 | 9.057781 | 1865 | 10.942219 | 10.002815 | 10.945034 | 29 |
| 32 | 9.056071 | 1836 | 9.997170 | 25 | 9.058900 | 1860 | 10.941100 | 10.002830 | 10.943929 | 28 |
| 33 | 9.057172 | 1831 | 9.997156 | 23 | 9.060016 | 1855 | 10.939984 | 10.002844 | 10.942828 | 27 |
| 34 | 9.058271 | 1827 | 9.997141 | 25 | 9.061130 | 1851 | 10.938870 | 10.002859 | 10.941729 | 26 |
| 35 | 9.059367 | 1822 | 9.997127 | 23 | 9.062240 | 1846 | 10.937760 | 10.002873 | 10.940633 | 25 |
| 36 | 9.060460 | 1817 | 9.997112 | 25 | 9.063348 | 1842 | 10.936652 | 10.002888 | 10.939540 | 24 |
| 37 | 9.061551 | 1813 | 9.997098 | 23 | 9.064453 | 1837 | 10.935547 | 10.002902 | 10.938449 | 23 |
| 38 | 9.062639 | 1808 | 9.997083 | 25 | 9.065556 | 1833 | 10.934444 | 10.002917 | 10.937361 | 22 |
| 39 | 9.063724 | 1804 | 9.997068 | 25 | 9.066655 | 1828 | 10.933345 | 10.002932 | 10.936276 | 21 |
| 40 | 9.064806 | 1799 | 9.997053 | 25 | 9.067752 | 1824 | 10.932248 | 10.002947 | 10.935194 | 20 |
| 41 | 9.065885 | 1794 | 9.997039 | 23 | 9.068846 | 1819 | 10.931154 | 10.002961 | 10.934115 | 19 |
| 42 | 9.066962 | 1790 | 9.997024 | 25 | 9.069938 | 1815 | 10.930062 | 10.002976 | 10.933038 | 18 |
| 43 | 9.068036 | 1786 | 9.997009 | 25 | 9.071027 | 1810 | 10.928973 | 10.002991 | 10.931964 | 17 |
| 44 | 9.069107 | 1781 | 9.996994 | 25 | 9.072113 | 1806 | 10.927887 | 10.003006 | 10.930893 | 16 |
| 45 | 9.070176 | 1777 | 9.996979 | 25 | 9.073197 | 1802 | 10.926803 | 10.003021 | 10.929824 | 15 |
| 46 | 9.071242 | 1772 | 9.996964 | 25 | 9.074278 | 1797 | 10.925722 | 10.003036 | 10.928758 | 14 |
| 47 | 9.072306 | 1768 | 9.996949 | 25 | 9.075356 | 1793 | 10.924644 | 10.003051 | 10.927694 | 13 |
| 48 | 9.073366 | 1763 | 9.996934 | 25 | 9.076432 | 1789 | 10.923568 | 10.003066 | 10.926634 | 12 |
| 49 | 9.074424 | 1759 | 9.996919 | 25 | 9.077505 | 1784 | 10.922495 | 10.003081 | 10.925576 | 11 |
| 50 | 9.075480 | 1755 | 9.996904 | 25 | 9.078576 | 1780 | 10.921424 | 10.003096 | 10.924520 | 10 |
| 51 | 9.076533 | 1750 | 9.996889 | 25 | 9.079644 | 1776 | 10.920356 | 10.003111 | 10.923467 | 9 |
| 52 | 9.077583 | 1746 | 9.996874 | 27 | 9.080710 | 1772 | 10.919290 | 10.003126 | 10.922417 | 8 |
| 53 | 9.078631 | 1742 | 9.996858 | 25 | 9.081773 | 1767 | 10.918227 | 10.003142 | 10.921369 | 7 |
| 54 | 9.079676 | 1738 | 9.996843 | 25 | 9.082833 | 1763 | 10.917167 | 10.003157 | 10.920324 | 6 |
| 55 | 9.080719 | 1733 | 9.996828 | 27 | 9.083891 | 1759 | 10.916109 | 10.003172 | 10.919281 | 5 |
| 56 | 9.081759 | 1729 | 9.996812 | 25 | 9.084947 | 1755 | 10.915053 | 10.003188 | 10.918241 | 4 |
| 57 | 9.082797 | 1725 | 9.996797 | 25 | 9.086000 | 1751 | 10.914000 | 10.003203 | 10.917203 | 3 |
| 58 | 9.083832 | 1721 | 9.996782 | 27 | 9.087050 | 1747 | 10.912950 | 10.003218 | 10.916168 | 2 |
| 59 | 9.084864 | 1717 | 9.996766 | 25 | 9.088098 | 1743 | 10.911902 | 10.003234 | 10.915136 | 1 |
| 60 | 9.085894 | | 9.996751 | | 9.089144 | | 10.910856 | 10.003249 | 10.914106 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 7 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.085894 | 1713 | 9.996751 | 27 | 9.089144 | 1738 | 10.910856 | 10.003249 | 10.914106 | 60 |
| 1 | 9.086922 | 1709 | 9.996735 | 25 | 9.090187 | 1735 | 10.909813 | 10.003265 | 10.913078 | 59 |
| 2 | 9.087947 | 1704 | 9.996720 | 27 | 9.091228 | 1731 | 10.908772 | 10.003280 | 10.912053 | 58 |
| 3 | 9.088970 | 1700 | 9.996704 | 27 | 9.092266 | 1727 | 10.907734 | 10.003296 | 10.911030 | 57 |
| 4 | 9.089990 | 1696 | 9.996688 | 25 | 9.093302 | 1722 | 10.906698 | 10.003312 | 10.910010 | 56 |
| 5 | 9.091008 | 1692 | 9.996673 | 27 | 9.094336 | 1719 | 10.905664 | 10.003327 | 10.908992 | 55 |
| 6 | 9.092024 | 1688 | 9.996657 | 27 | 9.095367 | 1715 | 10.904633 | 10.003343 | 10.907976 | 54 |
| 7 | 9.093037 | 1684 | 9.996641 | 27 | 9.096395 | 1711 | 10.903605 | 10.003359 | 10.906963 | 53 |
| 8 | 9.094047 | 1680 | 9.996625 | 25 | 9.097422 | 1707 | 10.902578 | 10.003375 | 10.905953 | 52 |
| 9 | 9.095056 | 1676 | 9.996610 | 27 | 9.098446 | 1703 | 10.901554 | 10.003390 | 10.904944 | 51 |
| 10 | 9.096062 | 1673 | 9.996594 | 27 | 9.099468 | 1699 | 10.900532 | 10.003406 | 10.903938 | 50 |
| 11 | 9.097065 | 1668 | 9.996578 | 27 | 9.100487 | 1695 | 10.899513 | 10.003422 | 10.902935 | 49 |
| 12 | 9.098066 | 1665 | 9.996562 | 27 | 9.101504 | 1691 | 10.898496 | 10.003438 | 10.901934 | 48 |
| 13 | 9.099065 | 1661 | 9.996546 | 27 | 9.102519 | 1687 | 10.897481 | 10.003454 | 10.900935 | 47 |
| 14 | 9.100062 | 1657 | 9.996530 | 27 | 9.103532 | 1684 | 10.896468 | 10.003470 | 10.899938 | 46 |
| 15 | 9.101056 | 1653 | 9.996514 | 27 | 9.104542 | 1680 | 10.895458 | 10.003486 | 10.898944 | 45 |
| 16 | 9.102048 | 1649 | 9.996498 | 27 | 9.105550 | 1676 | 10.894450 | 10.003502 | 10.897952 | 44 |
| 17 | 9.103037 | 1645 | 9.996482 | 28 | 9.106556 | 1672 | 10.893444 | 10.003518 | 10.896963 | 43 |
| 18 | 9.104025 | 1642 | 9.996465 | 27 | 9.107559 | 1669 | 10.892441 | 10.003535 | 10.895975 | 42 |
| 19 | 9.105010 | 1638 | 9.996449 | 27 | 9.108560 | 1665 | 10.891440 | 10.003551 | 10.894990 | 41 |
| 20 | 9.105992 | 1634 | 9.996433 | 27 | 9.109559 | 1661 | 10.890441 | 10.003567 | 10.894008 | 40 |
| 21 | 9.106973 | 1630 | 9.996417 | 28 | 9.110556 | 1658 | 10.889444 | 10.003583 | 10.893027 | 39 |
| 22 | 9.107951 | 1627 | 9.996400 | 27 | 9.111551 | 1654 | 10.888449 | 10.003600 | 10.892049 | 38 |
| 23 | 9.108927 | 1623 | 9.996384 | 27 | 9.112543 | 1650 | 10.887457 | 10.003616 | 10.891073 | 37 |
| 24 | 9.109901 | 1619 | 9.996368 | 28 | 9.113533 | 1647 | 10.886467 | 10.003632 | 10.890099 | 36 |
| 25 | 9.110873 | 1616 | 9.996351 | 27 | 9.114521 | 1643 | 10.885479 | 10.003649 | 10.889127 | 35 |
| 26 | 9.111842 | 1612 | 9.996335 | 28 | 9.115507 | 1639 | 10.884493 | 10.003665 | 10.888158 | 34 |
| 27 | 9.112809 | 1608 | 9.996318 | 27 | 9.116491 | 1636 | 10.883509 | 10.003682 | 10.887191 | 33 |
| 28 | 9.113774 | 1605 | 9.996302 | 28 | 9.117472 | 1632 | 10.882528 | 10.003698 | 10.886226 | 32 |
| 29 | 9.114737 | 1601 | 9.996285 | 27 | 9.118452 | 1629 | 10.881548 | 10.003715 | 10.885263 | 31 |
| 30 | 9.115698 | 1597 | 9.996269 | 28 | 9.119429 | 1625 | 10.880571 | 10.003731 | 10.884302 | 30 |
| 31 | 9.116656 | 1594 | 9.996252 | 28 | 9.120404 | 1622 | 10.879596 | 10.003748 | 10.883344 | 29 |
| 32 | 9.117613 | 1590 | 9.996235 | 27 | 9.121377 | 1618 | 10.878623 | 10.003765 | 10.882387 | 28 |
| 33 | 9.118567 | 1587 | 9.996219 | 28 | 9.122348 | 1615 | 10.877652 | 10.003781 | 10.881433 | 27 |
| 34 | 9.119519 | 1583 | 9.996202 | 28 | 9.123317 | 1611 | 10.876683 | 10.003798 | 10.880481 | 26 |
| 35 | 9.120469 | 1580 | 9.996185 | 28 | 9.124284 | 1608 | 10.875716 | 10.003815 | 10.879531 | 25 |
| 36 | 9.121417 | 1576 | 9.996168 | 28 | 9.125249 | 1604 | 10.874751 | 10.003832 | 10.878583 | 24 |
| 37 | 9.122362 | 1573 | 9.996151 | 28 | 9.126211 | 1601 | 10.873789 | 10.003849 | 10.877638 | 23 |
| 38 | 9.123306 | 1569 | 9.996134 | 28 | 9.127172 | 1597 | 10.872828 | 10.003866 | 10.876694 | 22 |
| 39 | 9.124248 | 1566 | 9.996117 | 28 | 9.128130 | 1594 | 10.871870 | 10.003883 | 10.875752 | 21 |
| 40 | 9.125187 | 1562 | 9.996100 | 28 | 9.129087 | 1591 | 10.870913 | 10.003900 | 10.874813 | 20 |
| 41 | 9.126125 | 1559 | 9.996083 | 28 | 9.130041 | 1587 | 10.869959 | 10.003917 | 10.873875 | 19 |
| 42 | 9.127060 | 1556 | 9.996066 | 28 | 9.130994 | 1584 | 10.869006 | 10.003934 | 10.872940 | 18 |
| 43 | 9.127993 | 1552 | 9.996049 | 28 | 9.131944 | 1581 | 10.868056 | 10.003951 | 10.872007 | 17 |
| 44 | 9.128925 | 1549 | 9.996032 | 28 | 9.132893 | 1577 | 10.867107 | 10.003968 | 10.871075 | 16 |
| 45 | 9.129854 | 1545 | 9.996015 | 28 | 9.133839 | 1574 | 10.866161 | 10.003985 | 10.870146 | 15 |
| 46 | 9.130781 | 1542 | 9.995998 | 30 | 9.134784 | 1571 | 10.865216 | 10.004002 | 10.869219 | 14 |
| 47 | 9.131706 | 1539 | 9.995980 | 28 | 9.135726 | 1567 | 10.864274 | 10.004020 | 10.868294 | 13 |
| 48 | 9.132630 | 1535 | 9.995963 | 28 | 9.136667 | 1564 | 10.863333 | 10.004037 | 10.867370 | 12 |
| 49 | 9.133551 | 1532 | 9.995946 | 30 | 9.137605 | 1561 | 10.862395 | 10.004054 | 10.866449 | 11 |
| 50 | 9.134470 | 1529 | 9.995928 | 28 | 9.138542 | 1558 | 10.861458 | 10.004072 | 10.865530 | 10 |
| 51 | 9.135387 | 1525 | 9.995911 | 28 | 9.139476 | 1555 | 10.860524 | 10.004089 | 10.864613 | 9 |
| 52 | 9.136303 | 1522 | 9.995894 | 30 | 9.140409 | 1551 | 10.859591 | 10.004106 | 10.863697 | 8 |
| 53 | 9.137216 | 1519 | 9.995876 | 28 | 9.141340 | 1548 | 10.858660 | 10.004124 | 10.862784 | 7 |
| 54 | 9.138128 | 1516 | 9.995859 | 30 | 9.142269 | 1545 | 10.857731 | 10.004141 | 10.861872 | 6 |
| 55 | 9.139037 | 1512 | 9.995841 | 30 | 9.143196 | 1542 | 10.856804 | 10.004159 | 10.860963 | 5 |
| 56 | 9.139944 | 1509 | 9.995823 | 28 | 9.144121 | 1539 | 10.855879 | 10.004177 | 10.860056 | 4 |
| 57 | 9.140850 | 1506 | 9.995806 | 30 | 9.145044 | 1535 | 10.854956 | 10.004194 | 10.859150 | 3 |
| 58 | 9.141754 | 1503 | 9.995788 | 28 | 9.145966 | 1532 | 10.854034 | 10.004212 | 10.858246 | 2 |
| 59 | 9.142655 | 1500 | 9.995771 | 30 | 9.146885 | 1529 | 10.853115 | 10.004229 | 10.857345 | 1 |
| 60 | 9.143555 | | 9.995753 | | 9.147803 | | 10.852197 | 10.004247 | 10.856445 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

8 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.143555 | 1496 | 9.995753 | 30 | 9.147803 | 1526 | 10.852197 | 10.004247 | 10.856445 | 60 |
| 1 | 9.144453 | 1493 | 9.995735 | 30 | 9.149328 | 1523 | 10.851282 | 10.004265 | 10.855547 | 59 |
| 2 | 9.145349 | 1490 | 9.995717 | 30 | 9.149632 | 1520 | 10.850368 | 10.004283 | 10.854651 | 58 |
| 3 | 9.146243 | 1487 | 9.995699 | 30 | 9.150544 | 1517 | 10.849456 | 10.004301 | 10.853757 | 57 |
| 4 | 9.147136 | 1484 | 9.995681 | 28 | 9.151454 | 1514 | 10.848546 | 10.004319 | 10.852864 | 56 |
| 5 | 9.148026 | 1481 | 9.995664 | 30 | 9.152363 | 1511 | 10.847637 | 10.004336 | 10.851974 | 55 |
| 6 | 9.148915 | 1478 | 9.995646 | 30 | 9.153269 | 1508 | 10.846731 | 10.004354 | 10.851085 | 54 |
| 7 | 9.149802 | 1475 | 9.995628 | 30 | 9.154174 | 1505 | 10.845826 | 10.004372 | 10.850198 | 53 |
| 8 | 9.150686 | 1472 | 9.995610 | 32 | 9.155077 | 1502 | 10.844923 | 10.004390 | 10.849314 | 52 |
| 9 | 9.151569 | 1469 | 9.995591 | 30 | 9.155978 | 1499 | 10.844022 | 10.004409 | 10.848431 | 51 |
| 10 | 9.152451 | 1466 | 9.995573 | 30 | 9.156877 | 1496 | 10.843123 | 10.004427 | 10.847549 | 50 |
| 11 | 9.153330 | 1462 | 9.995555 | 30 | 9.157775 | 1493 | 10.842225 | 10.004445 | 10.846670 | 49 |
| 12 | 9.154208 | 1460 | 9.995537 | 30 | 9.158671 | 1490 | 10.841329 | 10.004463 | 10.845792 | 48 |
| 13 | 9.155083 | 1457 | 9.995519 | 30 | 9.159565 | 1487 | 10.840435 | 10.004481 | 10.844917 | 47 |
| 14 | 9.155957 | 1454 | 9.995501 | 32 | 9.160457 | 1484 | 10.839543 | 10.004499 | 10.844043 | 46 |
| 15 | 9.156830 | 1451 | 9.995482 | 30 | 9.161347 | 1481 | 10.838653 | 10.004518 | 10.843170 | 45 |
| 16 | 9.157700 | 1448 | 9.995464 | 30 | 9.162236 | 1478 | 10.837764 | 10.004536 | 10.842300 | 44 |
| 17 | 9.158569 | 1445 | 9.995446 | 32 | 9.163123 | 1475 | 10.836877 | 10.004554 | 10.841431 | 43 |
| 18 | 9.159435 | 1442 | 9.995427 | 30 | 9.164008 | 1473 | 10.835992 | 10.004573 | 10.840565 | 42 |
| 19 | 9.160301 | 1439 | 9.995409 | 32 | 9.164892 | 1470 | 10.835108 | 10.004591 | 10.839699 | 41 |
| 20 | 9.161164 | 1436 | 9.995390 | 30 | 9.165774 | 1467 | 10.834226 | 10.004610 | 10.838836 | 40 |
| 21 | 9.162025 | 1433 | 9.995372 | 32 | 9.166654 | 1464 | 10.833346 | 10.004628 | 10.837975 | 39 |
| 22 | 9.162885 | 1430 | 9.995353 | 32 | 9.167532 | 1461 | 10.832468 | 10.004647 | 10.837115 | 38 |
| 23 | 9.163743 | 1427 | 9.995334 | 30 | 9.168409 | 1458 | 10.831591 | 10.004666 | 10.836257 | 37 |
| 24 | 9.164600 | 1424 | 9.995316 | 32 | 9.169284 | 1455 | 10.830716 | 10.004684 | 10.835400 | 36 |
| 25 | 9.165454 | 1422 | 9.995297 | 32 | 9.170157 | 1453 | 10.829843 | 10.004703 | 10.834546 | 35 |
| 26 | 9.166307 | 1419 | 9.995278 | 32 | 9.171029 | 1450 | 10.828971 | 10.004722 | 10.833693 | 34 |
| 27 | 9.167159 | 1416 | 9.995260 | 30 | 9.171899 | 1447 | 10.828101 | 10.004740 | 10.832841 | 33 |
| 28 | 9.168008 | 1413 | 9.995241 | 32 | 9.172767 | 1444 | 10.827233 | 10.004759 | 10.831992 | 32 |
| 29 | 9.168856 | 1410 | 9.995222 | 32 | 9.173634 | 1442 | 10.826366 | 10.004778 | 10.831144 | 31 |
| 30 | 9.169702 | 1407 | 9.995203 | 32 | 9.174499 | 1439 | 10.825501 | 10.004797 | 10.830298 | 30 |
| 31 | 9.170547 | 1405 | 9.995184 | 32 | 9.175362 | 1436 | 10.824638 | 10.004816 | 10.829453 | 29 |
| 32 | 9.171389 | 1402 | 9.995165 | 32 | 9.176224 | 1433 | 10.823776 | 10.004835 | 10.828611 | 28 |
| 33 | 9.172230 | 1399 | 9.995146 | 32 | 9.177084 | 1431 | 10.822916 | 10.004854 | 10.827770 | 27 |
| 34 | 9.173070 | 1396 | 9.995127 | 32 | 9.177942 | 1428 | 10.822058 | 10.004873 | 10.826930 | 26 |
| 35 | 9.173908 | 1394 | 9.995108 | 32 | 9.178799 | 1425 | 10.821201 | 10.004892 | 10.826092 | 25 |
| 36 | 9.174744 | 1391 | 9.995089 | 32 | 9.179655 | 1423 | 10.820345 | 10.004911 | 10.825256 | 24 |
| 37 | 9.175578 | 1388 | 9.995070 | 32 | 9.180508 | 1420 | 10.819492 | 10.004930 | 10.824422 | 23 |
| 38 | 9.176411 | 1385 | 9.995051 | 32 | 9.181360 | 1417 | 10.818640 | 10.004949 | 10.823589 | 22 |
| 39 | 9.177242 | 1383 | 9.995032 | 32 | 9.182211 | 1415 | 10.817789 | 10.004968 | 10.822758 | 21 |
| 40 | 9.178072 | 1380 | 9.995013 | 33 | 9.183059 | 1412 | 10.816941 | 10.004987 | 10.821928 | 20 |
| 41 | 9.178900 | 1377 | 9.994993 | 32 | 9.183907 | 1409 | 10.816093 | 10.005007 | 10.821100 | 19 |
| 42 | 9.179726 | 1374 | 9.994974 | 32 | 9.184752 | 1407 | 10.815248 | 10.005026 | 10.820274 | 18 |
| 43 | 9.180551 | 1372 | 9.994955 | 33 | 9.185597 | 1404 | 10.814403 | 10.005045 | 10.819449 | 17 |
| 44 | 9.181374 | 1369 | 9.994935 | 32 | 9.186439 | 1402 | 10.813561 | 10.005065 | 10.818626 | 16 |
| 45 | 9.182196 | 1367 | 9.994916 | 33 | 9.187280 | 1399 | 10.812720 | 10.005084 | 10.817804 | 15 |
| 46 | 9.183016 | 1364 | 9.994896 | 32 | 9.188120 | 1396 | 10.811880 | 10.005104 | 10.816984 | 14 |
| 47 | 9.183834 | 1361 | 9.994877 | 33 | 9.188958 | 1394 | 10.811042 | 10.005123 | 10.816166 | 13 |
| 48 | 9.184651 | 1359 | 9.994857 | 32 | 9.189794 | 1391 | 10.810206 | 10.005143 | 10.815349 | 12 |
| 49 | 9.185466 | 1356 | 9.994838 | 33 | 9.190629 | 1389 | 10.809371 | 10.005162 | 10.814534 | 11 |
| 50 | 9.186280 | 1353 | 9.994818 | 33 | 9.191462 | 1386 | 10.808538 | 10.005182 | 10.813720 | 10 |
| 51 | 9.187092 | 1351 | 9.994798 | 32 | 9.192294 | 1384 | 10.807706 | 10.005202 | 10.812908 | 9 |
| 52 | 9.187903 | 1348 | 9.994779 | 33 | 9.193124 | 1381 | 10.806876 | 10.005221 | 10.812097 | 8 |
| 53 | 9.188712 | 1346 | 9.994759 | 33 | 9.193953 | 1379 | 10.806047 | 10.005241 | 10.811288 | 7 |
| 54 | 9.189519 | 1343 | 9.994739 | 32 | 9.194780 | 1376 | 10.805220 | 10.005261 | 10.810481 | 6 |
| 55 | 9.190325 | 1341 | 9.994720 | 33 | 9.195606 | 1374 | 10.804394 | 10.005281 | 10.809675 | 5 |
| 56 | 9.191130 | 1338 | 9.994700 | 33 | 9.196430 | 1371 | 10.803570 | 10.005300 | 10.808870 | 4 |
| 57 | 9.191933 | 1336 | 9.994680 | 33 | 9.197253 | 1369 | 10.802747 | 10.005320 | 10.808067 | 3 |
| 58 | 9.192734 | 1333 | 9.994660 | 33 | 9.198074 | 1366 | 10.801926 | 10.005340 | 10.807266 | 2 |
| 59 | 9.193534 | 1330 | 9.994640 | 33 | 9.198894 | 1364 | 10.801106 | 10.005360 | 10.806466 | 1 |
| 60 | 9.194332 | | 9.994620 | | 9.199713 | | 10.800287 | 10.005380 | 10.805668 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

81 Degrees.

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# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

9 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.194332 | 1328 | 9.994620 | 33 | 9.199713 | 1361 | 10.800287 | 10.005380 | 10.805668 | 60 |
| 1 | 9.195129 | 1326 | 9.994600 | 33 | 9.200529 | 1359 | 10.799471 | 10.005400 | 10.804871 | 59 |
| 2 | 9.195925 | 1323 | 9.994580 | 33 | 9.201345 | 1356 | 10.798655 | 10.005420 | 10.804075 | 58 |
| 3 | 9.196719 | 1321 | 9.994560 | 33 | 9.202159 | 1354 | 10.797841 | 10.005440 | 10.803281 | 57 |
| 4 | 9.197511 | 1318 | 9.994540 | 35 | 9.202971 | 1352 | 10.797029 | 10.005460 | 10.802489 | 56 |
| 5 | 9.198302 | 1316 | 9.994519 | 33 | 9.203782 | 1349 | 10.796218 | 10.005481 | 10.801698 | 55 |
| 6 | 9.199091 | 1313 | 9.994499 | 33 | 9.204592 | 1347 | 10.795408 | 10.005501 | 10.800909 | 54 |
| 7 | 9.199879 | 1311 | 9.994479 | 33 | 9.205400 | 1345 | 10.794600 | 10.005521 | 10.800121 | 53 |
| 8 | 9.200666 | 1308 | 9.994459 | 35 | 9.206207 | 1342 | 10.793793 | 10.005541 | 10.799334 | 52 |
| 9 | 9.201451 | 1306 | 9.994438 | 33 | 9.207013 | 1340 | 10.792987 | 10.005562 | 10.798549 | 51 |
| 10 | 9.202234 | 1304 | 9.994418 | 33 | 9.207817 | 1338 | 10.792183 | 10.005582 | 10.797766 | 50 |
| 11 | 9.203017 | 1301 | 9.994398 | 35 | 9.208619 | 1335 | 10.791381 | 10.005602 | 10.796983 | 49 |
| 12 | 9.203797 | 1299 | 9.994377 | 33 | 9.209420 | 1333 | 10.790580 | 10.005623 | 10.796203 | 48 |
| 13 | 9.204577 | 1296 | 9.994357 | 35 | 9.210220 | 1331 | 10.789780 | 10.005643 | 10.795423 | 47 |
| 14 | 9.205354 | 1294 | 9.994336 | 33 | 9.211018 | 1328 | 10.788982 | 10.005664 | 10.794646 | 46 |
| 15 | 9.206131 | 1292 | 9.994316 | 35 | 9.211815 | 1326 | 10.788185 | 10.005684 | 10.793869 | 45 |
| 16 | 9.206906 | 1289 | 9.994295 | 35 | 9.212611 | 1324 | 10.787389 | 10.005705 | 10.793094 | 44 |
| 17 | 9.207679 | 1287 | 9.994274 | 33 | 9.213405 | 1321 | 10.786595 | 10.005726 | 10.792321 | 43 |
| 18 | 9.208452 | 1285 | 9.994254 | 35 | 9.214198 | 1319 | 10.785802 | 10.005746 | 10.791548 | 42 |
| 19 | 9.209222 | 1282 | 9.994233 | 35 | 9.214989 | 1317 | 10.785011 | 10.005767 | 10.790778 | 41 |
| 20 | 9.209992 | 1280 | 9.994212 | 35 | 9.215780 | 1315 | 10.784220 | 10.005788 | 10.790008 | 40 |
| 21 | 9.210760 | 1278 | 9.994191 | 33 | 9.216568 | 1312 | 10.783432 | 10.005809 | 10.789240 | 39 |
| 22 | 9.211526 | 1275 | 9.994171 | 35 | 9.217356 | 1310 | 10.782644 | 10.005829 | 10.788474 | 38 |
| 23 | 9.212291 | 1273 | 9.994150 | 35 | 9.218142 | 1308 | 10.781858 | 10.005850 | 10.787709 | 37 |
| 24 | 9.213055 | 1271 | 9.994129 | 35 | 9.218926 | 1305 | 10.781074 | 10.005871 | 10.786945 | 36 |
| 25 | 9.213818 | 1268 | 9.994108 | 35 | 9.219710 | 1303 | 10.780290 | 10.005892 | 10.786182 | 35 |
| 26 | 9.214579 | 1266 | 9.994087 | 35 | 9.220492 | 1301 | 10.779508 | 10.005913 | 10.785421 | 34 |
| 27 | 9.215338 | 1264 | 9.994066 | 35 | 9.221272 | 1299 | 10.778728 | 10.005934 | 10.784662 | 33 |
| 28 | 9.216097 | 1261 | 9.994045 | 35 | 9.222052 | 1297 | 10.777948 | 10.005955 | 10.783903 | 32 |
| 29 | 9.216854 | 1259 | 9.994024 | 35 | 9.222830 | 1294 | 10.777170 | 10.005976 | 10.783146 | 31 |
| 30 | 9.217609 | 1257 | 9.994003 | 35 | 9.223607 | 1292 | 10.776393 | 10.005997 | 10.782391 | 30 |
| 31 | 9.218363 | 1255 | 9.993982 | 37 | 9.224382 | 1290 | 10.775618 | 10.006018 | 10.781637 | 29 |
| 32 | 9.219116 | 1253 | 9.993960 | 35 | 9.225156 | 1288 | 10.774844 | 10.006040 | 10.780884 | 28 |
| 33 | 9.219868 | 1250 | 9.993939 | 35 | 9.225929 | 1286 | 10.774071 | 10.006061 | 10.780132 | 27 |
| 34 | 9.220618 | 1248 | 9.993918 | 35 | 9.226700 | 1284 | 10.773300 | 10.006082 | 10.779382 | 26 |
| 35 | 9.221367 | 1246 | 9.993897 | 37 | 9.227471 | 1281 | 10.772529 | 10.006103 | 10.778633 | 25 |
| 36 | 9.222115 | 1244 | 9.993875 | 35 | 9.228239 | 1279 | 10.771761 | 10.006125 | 10.777885 | 24 |
| 37 | 9.222861 | 1242 | 9.993854 | 37 | 9.229007 | 1277 | 10.770993 | 10.006146 | 10.777139 | 23 |
| 38 | 9.223606 | 1239 | 9.993832 | 35 | 9.229773 | 1275 | 10.770227 | 10.006168 | 10.776394 | 22 |
| 39 | 9.224349 | 1237 | 9.993811 | 37 | 9.230539 | 1273 | 10.769461 | 10.006189 | 10.775651 | 21 |
| 40 | 9.225092 | 1235 | 9.993789 | 35 | 9.231302 | 1271 | 10.768698 | 10.006211 | 10.774908 | 20 |
| 41 | 9.225833 | 1233 | 9.993768 | 37 | 9.232065 | 1269 | 10.767935 | 10.006232 | 10.774167 | 19 |
| 42 | 9.226573 | 1231 | 9.993746 | 35 | 9.232826 | 1267 | 10.767174 | 10.006254 | 10.773427 | 18 |
| 43 | 9.227311 | 1228 | 9.993725 | 37 | 9.233586 | 1265 | 10.766414 | 10.006275 | 10.772689 | 17 |
| 44 | 9.228048 | 1226 | 9.993703 | 37 | 9.234345 | 1262 | 10.765655 | 10.006297 | 10.771952 | 16 |
| 45 | 9.228784 | 1224 | 9.993681 | 35 | 9.235103 | 1260 | 10.764897 | 10.006319 | 10.771216 | 15 |
| 46 | 9.229518 | 1222 | 9.993660 | 37 | 9.235859 | 1258 | 10.764141 | 10.006340 | 10.770482 | 14 |
| 47 | 9.230252 | 1220 | 9.993638 | 37 | 9.236614 | 1256 | 10.763386 | 10.006362 | 10.769748 | 13 |
| 48 | 9.230984 | 1218 | 9.993616 | 37 | 9.237368 | 1254 | 10.762632 | 10.006384 | 10.769016 | 12 |
| 49 | 9.231715 | 1216 | 9.993594 | 37 | 9.238120 | 1252 | 10.761880 | 10.006406 | 10.768285 | 11 |
| 50 | 9.232444 | 1214 | 9.993572 | 37 | 9.238872 | 1250 | 10.761128 | 10.006428 | 10.767556 | 10 |
| 51 | 9.233172 | 1212 | 9.993550 | 37 | 9.239622 | 1248 | 10.760378 | 10.006450 | 10.766828 | 9 |
| 52 | 9.233899 | 1209 | 9.993528 | 37 | 9.240371 | 1246 | 10.759629 | 10.006472 | 10.766101 | 8 |
| 53 | 9.234625 | 1207 | 9.993506 | 37 | 9.241118 | 1244 | 10.758882 | 10.006494 | 10.765375 | 7 |
| 54 | 9.235349 | 1205 | 9.993484 | 37 | 9.241865 | 1242 | 10.758135 | 10.006516 | 10.764651 | 6 |
| 55 | 9.236073 | 1203 | 9.993462 | 37 | 9.242610 | 1240 | 10.757390 | 10.006538 | 10.763927 | 5 |
| 56 | 9.236795 | 1201 | 9.993440 | 37 | 9.243354 | 1238 | 10.756646 | 10.006560 | 10.763205 | 4 |
| 57 | 9.237515 | 1199 | 9.993418 | 37 | 9.244097 | 1236 | 10.755903 | 10.006582 | 10.762485 | 3 |
| 58 | 9.238235 | 1197 | 9.993396 | 37 | 9.244839 | 1234 | 10.755161 | 10.006604 | 10.761765 | 2 |
| 59 | 9.238953 | 1195 | 9.993374 | 37 | 9.245579 | 1232 | 10.754421 | 10.006626 | 10.761047 | 1 |
| 60 | 9.239670 | | 9.993351 | 38 | 9.246319 | | 10.753681 | 10.006649 | 10.760330 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

80 Degrees.

10 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.239670 | 1193 | 9.993351 | 37 | 9.246319 | 1230 | 10.753681 | 10.006649 | 10.760330 | 60 |
| 1 | 9.240386 | 1191 | 9.993329 | 37 | 9.247057 | 1228 | 10.752943 | 10.006671 | 10.759614 | 59 |
| 2 | 9.241101 | 1189 | 9.993307 | 38 | 9.247794 | 1226 | 10.752206 | 10.006693 | 10.758899 | 58 |
| 3 | 9.241814 | 1187 | 9.993285 | 37 | 9.248530 | 1224 | 10.751470 | 10.006715 | 10.758186 | 57 |
| 4 | 9.242526 | 1185 | 9.993262 | 37 | 9.249264 | 1222 | 10.750736 | 10.006738 | 10.757474 | 56 |
| 5 | 9.243237 | 1183 | 9.993240 | 38 | 9.249998 | 1220 | 10.750002 | 10.006760 | 10.756763 | 55 |
| 6 | 9.243947 | 1181 | 9.993217 | 37 | 9.250730 | 1218 | 10.749270 | 10.006783 | 10.756053 | 54 |
| 7 | 9.244656 | 1179 | 9.993195 | 38 | 9.251461 | 1217 | 10.748539 | 10.006805 | 10.755344 | 53 |
| 8 | 9.245363 | 1177 | 9.993172 | 38 | 9.252191 | 1215 | 10.747809 | 10.006828 | 10.754637 | 52 |
| 9 | 9.246069 | 1175 | 9.993149 | 38 | 9.252920 | 1213 | 10.747080 | 10.006851 | 10.753931 | 51 |
| 10 | 9.246775 | 1173 | 9.993127 | 37 | 9.253648 | 1211 | 10.746352 | 10.006873 | 10.753225 | 50 |
| 11 | 9.247478 | 1171 | 9.993104 | 38 | 9.254374 | 1209 | 10.745626 | 10.006896 | 10.752522 | 49 |
| 12 | 9.248181 | 1169 | 9.993081 | 37 | 9.255100 | 1207 | 10.744900 | 10.006919 | 10.751819 | 48 |
| 13 | 9.248883 | 1167 | 9.993059 | 38 | 9.255824 | 1205 | 10.744176 | 10.006941 | 10.751117 | 47 |
| 14 | 9.249583 | 1165 | 9.993036 | 38 | 9.256547 | 1203 | 10.743453 | 10.006964 | 10.750417 | 46 |
| 15 | 9.250282 | 1163 | 9.993013 | 38 | 9.257269 | 1201 | 10.742731 | 10.006987 | 10.749718 | 45 |
| 16 | 9.250980 | 1161 | 9.992990 | 38 | 9.257990 | 1200 | 10.742010 | 10.007010 | 10.749020 | 44 |
| 17 | 9.251677 | 1159 | 9.992967 | 38 | 9.258710 | 1198 | 10.741290 | 10.007033 | 10.748323 | 43 |
| 18 | 9.252373 | 1158 | 9.992944 | 38 | 9.259429 | 1196 | 10.740571 | 10.007056 | 10.747627 | 42 |
| 19 | 9.253067 | 1156 | 9.992921 | 38 | 9.260146 | 1194 | 10.739854 | 10.007079 | 10.746933 | 41 |
| 20 | 9.253761 | 1154 | 9.992898 | 38 | 9.260863 | 1192 | 10.739137 | 10.007102 | 10.746239 | 40 |
| 21 | 9.254453 | 1152 | 9.992875 | 38 | 9.261578 | 1190 | 10.738422 | 10.007125 | 10.745547 | 39 |
| 22 | 9.255144 | 1150 | 9.992852 | 38 | 9.262292 | 1189 | 10.737708 | 10.007148 | 10.744856 | 38 |
| 23 | 9.255834 | 1148 | 9.992829 | 38 | 9.263005 | 1187 | 10.736995 | 10.007171 | 10.744166 | 37 |
| 24 | 9.256523 | 1146 | 9.992806 | 38 | 9.263717 | 1185 | 10.736283 | 10.007194 | 10.743477 | 36 |
| 25 | 9.257211 | 1144 | 9.992783 | 40 | 9.264428 | 1183 | 10.735572 | 10.007217 | 10.742789 | 35 |
| 26 | 9.257898 | 1142 | 9.992759 | 38 | 9.265138 | 1181 | 10.734862 | 10.007241 | 10.742102 | 34 |
| 27 | 9.258583 | 1141 | 9.992736 | 38 | 9.265847 | 1179 | 10.734153 | 10.007264 | 10.741417 | 33 |
| 28 | 9.259268 | 1139 | 9.992713 | 38 | 9.266555 | 1178 | 10.733445 | 10.007287 | 10.740732 | 32 |
| 29 | 9.259951 | 1137 | 9.992690 | 40 | 9.267261 | 1176 | 10.732739 | 10.007311 | 10.740049 | 31 |
| 30 | 9.260633 | 1135 | 9.992666 | 38 | 9.267967 | 1174 | 10.732033 | 10.007334 | 10.739367 | 30 |
| 31 | 9.261314 | 1133 | 9.992643 | 40 | 9.268671 | 1172 | 10.731329 | 10.007357 | 10.738686 | 29 |
| 32 | 9.261994 | 1131 | 9.992619 | 38 | 9.269375 | 1170 | 10.730625 | 10.007381 | 10.738006 | 28 |
| 33 | 9.262673 | 1130 | 9.992596 | 40 | 9.270077 | 1169 | 10.729923 | 10.007404 | 10.737327 | 27 |
| 34 | 9.263351 | 1128 | 9.992572 | 38 | 9.270779 | 1167 | 10.729221 | 10.007428 | 10.736649 | 26 |
| 35 | 9.264027 | 1126 | 9.992549 | 40 | 9.271479 | 1165 | 10.728521 | 10.007451 | 10.735973 | 25 |
| 36 | 9.264703 | 1124 | 9.992525 | 40 | 9.272178 | 1164 | 10.727822 | 10.007475 | 10.735297 | 24 |
| 37 | 9.265377 | 1122 | 9.992501 | 38 | 9.272876 | 1162 | 10.727124 | 10.007499 | 10.734623 | 23 |
| 38 | 9.266051 | 1120 | 9.992478 | 40 | 9.273573 | 1160 | 10.726427 | 10.007522 | 10.733949 | 22 |
| 39 | 9.266723 | 1119 | 9.992454 | 40 | 9.274269 | 1158 | 10.725731 | 10.007546 | 10.733277 | 21 |
| 40 | 9.267395 | 1117 | 9.992430 | 40 | 9.274964 | 1157 | 10.725036 | 10.007570 | 10.732605 | 20 |
| 41 | 9.268065 | 1115 | 9.992406 | 40 | 9.275658 | 1155 | 10.724342 | 10.007594 | 10.731935 | 19 |
| 42 | 9.268734 | 1113 | 9.992382 | 38 | 9.276351 | 1153 | 10.723649 | 10.007618 | 10.731266 | 18 |
| 43 | 9.269402 | 1111 | 9.992358 | 40 | 9.277043 | 1151 | 10.722957 | 10.007642 | 10.730598 | 17 |
| 44 | 9.270069 | 1110 | 9.992335 | 40 | 9.277734 | 1150 | 10.722266 | 10.007665 | 10.729931 | 16 |
| 45 | 9.270735 | 1108 | 9.992311 | 40 | 9.278424 | 1148 | 10.721576 | 10.007689 | 10.729265 | 15 |
| 46 | 9.271400 | 1106 | 9.992287 | 40 | 9.279113 | 1146 | 10.720887 | 10.007713 | 10.728600 | 14 |
| 47 | 9.272064 | 1105 | 9.992263 | 40 | 9.279801 | 1145 | 10.720199 | 10.007737 | 10.727936 | 13 |
| 48 | 9.272726 | 1103 | 9.992239 | 42 | 9.280488 | 1143 | 10.719512 | 10.007761 | 10.727274 | 12 |
| 49 | 9.273388 | 1101 | 9.992214 | 40 | 9.281174 | 1141 | 10.718826 | 10.007786 | 10.726612 | 11 |
| 50 | 9.274049 | 1099 | 9.992190 | 40 | 9.281858 | 1140 | 10.718142 | 10.007810 | 10.725951 | 10 |
| 51 | 9.274708 | 1098 | 9.992166 | 40 | 9.282542 | 1138 | 10.717458 | 10.007834 | 10.725292 | 9 |
| 52 | 9.275367 | 1096 | 9.992142 | 40 | 9.283225 | 1136 | 10.716775 | 10.007858 | 10.724633 | 8 |
| 53 | 9.276025 | 1094 | 9.992118 | 42 | 9.283907 | 1135 | 10.716093 | 10.007882 | 10.723975 | 7 |
| 54 | 9.276681 | 1092 | 9.992093 | 40 | 9.284588 | 1133 | 10.715412 | 10.007907 | 10.723319 | 6 |
| 55 | 9.277337 | 1091 | 9.992069 | 42 | 9.285268 | 1131 | 10.714732 | 10.007931 | 10.722663 | 5 |
| 56 | 9.277991 | 1089 | 9.992044 | 40 | 9.285947 | 1130 | 10.714053 | 10.007956 | 10.722009 | 4 |
| 57 | 9.278645 | 1087 | 9.992020 | 40 | 9.286624 | 1128 | 10.713376 | 10.007980 | 10.721355 | 3 |
| 58 | 9.279297 | 1086 | 9.991996 | 42 | 9.287301 | 1126 | 10.712699 | 10.008004 | 10.720703 | 2 |
| 59 | 9.279948 | 1084 | 9.991971 | 40 | 9.287977 | 1125 | 10.712023 | 10.008029 | 10.720052 | 1 |
| 60 | 9.280599 | | 9.991947 | | 9.288652 | | 10.711348 | 10.008053 | 10.719401 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

79 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 11 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.280599 | 1082 | 9.991947 | 42 | 9.288652 | 1123 | 10.711348 | 10.008053 | 10.719401 | 60 |
| 1 | 9.281248 | 1081 | 9.991922 | 42 | 9.289326 | 1122 | 10.710674 | 10.008078 | 10.718752 | 59 |
| 2 | 9.281897 | 1079 | 9.991897 | 40 | 9.289999 | 1120 | 10.710001 | 10.008103 | 10.718103 | 58 |
| 3 | 9.282544 | 1077 | 9.991873 | 42 | 9.290671 | 1118 | 10.709329 | 10.008127 | 10.717456 | 57 |
| 4 | 9.283190 | 1076 | 9.991848 | 42 | 9.291342 | 1117 | 10.708658 | 10.008152 | 10.716810 | 56 |
| 5 | 9.283836 | 1074 | 9.991823 | 42 | 9.292013 | 1115 | 10.707987 | 10.008177 | 10.716164 | 55 |
| 6 | 9.284480 | 1072 | 9.991799 | 40 | 9.292682 | 1114 | 10.707318 | 10.008201 | 10.715520 | 54 |
| 7 | 9.285124 | 1071 | 9.991774 | 42 | 9.293350 | 1112 | 10.706650 | 10.008226 | 10.714876 | 53 |
| 8 | 9.285766 | 1069 | 9.991749 | 42 | 9.294017 | 1111 | 10.705983 | 10.008251 | 10.714234 | 52 |
| 9 | 9.286408 | 1067 | 9.991724 | 42 | 9.294684 | 1109 | 10.705316 | 10.008276 | 10.713592 | 51 |
| 10 | 9.287048 | 1066 | 9.991699 | 42 | 9.295349 | 1107 | 10.704651 | 10.008301 | 10.712952 | 50 |
| 11 | 9.287688 | 1064 | 9.991674 | 42 | 9.296013 | 1106 | 10.703987 | 10.008326 | 10.712312 | 49 |
| 12 | 9.288326 | 1063 | 9.991649 | 42 | 9.296677 | 1104 | 10.703323 | 10.008351 | 10.711674 | 48 |
| 13 | 9.288964 | 1061 | 9.991624 | 42 | 9.297339 | 1103 | 10.702661 | 10.008376 | 10.711036 | 47 |
| 14 | 9.289600 | 1059 | 9.991599 | 42 | 9.298001 | 1101 | 10.701999 | 10.008401 | 10.710400 | 46 |
| 15 | 9.290236 | 1058 | 9.991574 | 42 | 9.298662 | 1100 | 10.701338 | 10.008426 | 10.709764 | 45 |
| 16 | 9.290870 | 1056 | 9.991549 | 42 | 9.299322 | 1098 | 10.700678 | 10.008451 | 10.709130 | 44 |
| 17 | 9.291504 | 1054 | 9.991524 | 43 | 9.299980 | 1096 | 10.700020 | 10.008476 | 10.708496 | 43 |
| 18 | 9.292137 | 1053 | 9.991498 | 42 | 9.300638 | 1095 | 10.699362 | 10.008502 | 10.707863 | 42 |
| 19 | 9.292768 | 1051 | 9.991473 | 42 | 9.301295 | 1093 | 10.698705 | 10.008527 | 10.707232 | 41 |
| 20 | 9.293399 | 1050 | 9.991448 | 43 | 9.301951 | 1092 | 10.698049 | 10.008552 | 10.706601 | 40 |
| 21 | 9.294029 | 1048 | 9.991422 | 42 | 9.302607 | 1090 | 10.697393 | 10.008578 | 10.705971 | 39 |
| 22 | 9.294658 | 1046 | 9.991397 | 42 | 9.303261 | 1089 | 10.696739 | 10.008603 | 10.705342 | 38 |
| 23 | 9.295286 | 1045 | 9.991372 | 42 | 9.303914 | 1087 | 10.696086 | 10.008628 | 10.704714 | 37 |
| 24 | 9.295913 | 1043 | 9.991346 | 43 | 9.304567 | 1086 | 10.695433 | 10.008654 | 10.704087 | 36 |
| 25 | 9.296539 | 1042 | 9.991321 | 42 | 9.305218 | 1084 | 10.694782 | 10.008679 | 10.703461 | 35 |
| 26 | 9.297164 | 1040 | 9.991295 | 43 | 9.305869 | 1083 | 10.694131 | 10.008705 | 10.702836 | 34 |
| 27 | 9.297788 | 1039 | 9.991270 | 42 | 9.306519 | 1081 | 10.693481 | 10.008730 | 10.702212 | 33 |
| 28 | 9.298412 | 1037 | 9.991244 | 43 | 9.307168 | 1080 | 10.692832 | 10.008756 | 10.701588 | 32 |
| 29 | 9.299034 | 1036 | 9.991218 | 43 | 9.307815 | 1078 | 10.692185 | 10.008782 | 10.700966 | 31 |
| 30 | 9.299655 | 1034 | 9.991193 | 42 | 9.308462 | 1077 | 10.691537 | 10.008807 | 10.700345 | 30 |
| 31 | 9.300276 | 1032 | 9.991167 | 43 | 9.309109 | 1075 | 10.690891 | 10.008833 | 10.699724 | 29 |
| 32 | 9.300895 | 1031 | 9.991141 | 43 | 9.309754 | 1074 | 10.690246 | 10.008859 | 10.699105 | 28 |
| 33 | 9.301514 | 1029 | 9.991115 | 43 | 9.310398 | 1073 | 10.689602 | 10.008885 | 10.698486 | 27 |
| 34 | 9.302132 | 1028 | 9.991090 | 42 | 9.311042 | 1071 | 10.688958 | 10.008910 | 10.697868 | 26 |
| 35 | 9.302748 | 1026 | 9.991064 | 43 | 9.311685 | 1070 | 10.688315 | 10.008936 | 10.697252 | 25 |
| 36 | 9.303364 | 1025 | 9.991038 | 43 | 9.312327 | 1068 | 10.687673 | 10.008962 | 10.696636 | 24 |
| 37 | 9.303979 | 1023 | 9.991012 | 43 | 9.312967 | 1067 | 10.687033 | 10.008988 | 10.696021 | 23 |
| 38 | 9.304593 | 1022 | 9.990986 | 43 | 9.313608 | 1065 | 10.686392 | 10.009014 | 10.695407 | 22 |
| 39 | 9.305207 | 1020 | 9.990960 | 43 | 9.314247 | 1064 | 10.685753 | 10.009040 | 10.694793 | 21 |
| 40 | 9.305819 | 1019 | 9.990934 | 43 | 9.314885 | 1062 | 10.685115 | 10.009066 | 10.694181 | 20 |
| 41 | 9.306430 | 1017 | 9.990908 | 43 | 9.315523 | 1061 | 10.684477 | 10.009092 | 10.693570 | 19 |
| 42 | 9.307041 | 1016 | 9.990882 | 45 | 9.316159 | 1060 | 10.683841 | 10.009118 | 10.692959 | 18 |
| 43 | 9.307650 | 1014 | 9.990855 | 43 | 9.316795 | 1058 | 10.683205 | 10.009145 | 10.692350 | 17 |
| 44 | 9.308259 | 1013 | 9.990829 | 43 | 9.317430 | 1057 | 10.682570 | 10.009171 | 10.691741 | 16 |
| 45 | 9.308867 | 1011 | 9.990803 | 43 | 9.318064 | 1055 | 10.681936 | 10.009197 | 10.691133 | 15 |
| 46 | 9.309474 | 1010 | 9.990777 | 45 | 9.318697 | 1054 | 10.681303 | 10.009223 | 10.690526 | 14 |
| 47 | 9.310080 | 1008 | 9.990750 | 43 | 9.319329 | 1053 | 10.680671 | 10.009250 | 10.689920 | 13 |
| 48 | 9.310685 | 1007 | 9.990724 | 45 | 9.319961 | 1051 | 10.680039 | 10.009276 | 10.689315 | 12 |
| 49 | 9.311289 | 1006 | 9.990697 | 43 | 9.320592 | 1050 | 10.679408 | 10.009303 | 10.688711 | 11 |
| 50 | 9.311893 | 1004 | 9.990671 | 43 | 9.321222 | 1048 | 10.678778 | 10.009329 | 10.688107 | 10 |
| 51 | 9.312495 | 1003 | 9.990645 | 45 | 9.321851 | 1047 | 10.678149 | 10.009355 | 10.687505 | 9 |
| 52 | 9.313097 | 1001 | 9.990618 | 45 | 9.322479 | 1045 | 10.677521 | 10.009382 | 10.686903 | 8 |
| 53 | 9.313698 | 1000 | 9.990591 | 43 | 9.323106 | 1044 | 10.676894 | 10.009409 | 10.686302 | 7 |
| 54 | 9.314297 | 998 | 9.990565 | 45 | 9.323733 | 1043 | 10.676267 | 10.009435 | 10.685703 | 6 |
| 55 | 9.314897 | 997 | 9.990538 | 45 | 9.324358 | 1041 | 10.675642 | 10.009462 | 10.685103 | 5 |
| 56 | 9.315495 | 996 | 9.990511 | 43 | 9.324983 | 1040 | 10.675017 | 10.009489 | 10.684505 | 4 |
| 57 | 9.316092 | 994 | 9.990485 | 45 | 9.325607 | 1039 | 10.674393 | 10.009515 | 10.683908 | 3 |
| 58 | 9.316689 | 993 | 9.990458 | 45 | 9.326231 | 1037 | 10.673769 | 10.009542 | 10.683311 | 2 |
| 59 | 9.317284 | 991 | 9.990431 | 45 | 9.326853 | 1036 | 10.673147 | 10.009569 | 10.682716 | 1 |
| 60 | 9.317879 | | 9.990404 | | 9.327475 | | 10.672525 | 10.009596 | 10.682121 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 12 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.317879 | 990 | 9.990404 | 43 | 9.327474 | 1035 | 10.672526 | 10.009596 | 10.682121 | 60 |
| 1 | 9.318473 | 988 | 9.990378 | 45 | 9.328095 | 1033 | 10.671905 | 10.009622 | 10.681527 | 59 |
| 2 | 9.319066 | 987 | 9.990351 | 45 | 9.328715 | 1032 | 10.671285 | 10.009649 | 10.680934 | 58 |
| 3 | 9.319658 | 986 | 9.990324 | 45 | 9.329334 | 1030 | 10.670666 | 10.009676 | 10.680342 | 57 |
| 4 | 9.320249 | 984 | 9.990297 | 45 | 9.329953 | 1029 | 10.670047 | 10.009703 | 10.679751 | 56 |
| 5 | 9.320840 | 983 | 9.990270 | 45 | 9.330570 | 1028 | 10.669430 | 10.009730 | 10.679160 | 55 |
| 6 | 9.321430 | 982 | 9.990243 | 47 | 9.331187 | 1026 | 10.668813 | 10.009757 | 10.678570 | 54 |
| 7 | 9.322019 | 980 | 9.990215 | 45 | 9.331803 | 1025 | 10.668197 | 10.009785 | 10.677981 | 53 |
| 8 | 9.322607 | 979 | 9.990188 | 45 | 9.332418 | 1024 | 10.667582 | 10.009812 | 10.677393 | 52 |
| 9 | 9.323194 | 977 | 9.990161 | 45 | 9.333033 | 1023 | 10.666967 | 10.009839 | 10.676806 | 51 |
| 10 | 9.323780 | 976 | 9.990134 | 45 | 9.333646 | 1021 | 10.666354 | 10.009866 | 10.676220 | 50 |
| 11 | 9.324366 | 975 | 9.990107 | 47 | 9.334259 | 1020 | 10.665741 | 10.009893 | 10.675634 | 49 |
| 12 | 9.324950 | 973 | 9.990079 | 45 | 9.334871 | 1019 | 10.665129 | 10.009921 | 10.675050 | 48 |
| 13 | 9.325534 | 972 | 9.990052 | 45 | 9.335482 | 1017 | 10.664518 | 10.009948 | 10.674466 | 47 |
| 14 | 9.326117 | 970 | 9.990025 | 45 | 9.336093 | 1016 | 10.663907 | 10.009975 | 10.673883 | 46 |
| 15 | 9.326700 | 969 | 9.989997 | 47 | 9.336702 | 1015 | 10.663298 | 10.010003 | 10.673300 | 45 |
| 16 | 9.327281 | 968 | 9.989970 | 45 | 9.337311 | 1013 | 10.662689 | 10.010030 | 10.672719 | 44 |
| 17 | 9.327862 | 966 | 9.989942 | 47 | 9.337919 | 1012 | 10.662081 | 10.010058 | 10.672138 | 43 |
| 18 | 9.328442 | 965 | 9.989915 | 45 | 9.338527 | 1011 | 10.661473 | 10.010085 | 10.671558 | 42 |
| 19 | 9.329021 | 964 | 9.989887 | 45 | 9.339133 | 1010 | 10.660867 | 10.010113 | 10.670979 | 41 |
| 20 | 9.329599 | 962 | 9.989860 | 47 | 9.339739 | 1008 | 10.660261 | 10.010140 | 10.670401 | 40 |
| 21 | 9.330176 | 961 | 9.989832 | 47 | 9.340344 | 1007 | 10.659656 | 10.010168 | 10.669824 | 39 |
| 22 | 9.330753 | 960 | 9.989804 | 45 | 9.340948 | 1006 | 10.659052 | 10.010196 | 10.669247 | 38 |
| 23 | 9.331329 | 958 | 9.989777 | 47 | 9.341552 | 1004 | 10.658448 | 10.010223 | 10.668671 | 37 |
| 24 | 9.331903 | 957 | 9.989749 | 47 | 9.342155 | 1003 | 10.657845 | 10.010251 | 10.668097 | 36 |
| 25 | 9.332478 | 956 | 9.989721 | 47 | 9.342757 | 1002 | 10.657243 | 10.010279 | 10.667522 | 35 |
| 26 | 9.333051 | 954 | 9.989693 | 47 | 9.343358 | 1001 | 10.656642 | 10.010307 | 10.666949 | 34 |
| 27 | 9.333624 | 953 | 9.989665 | 47 | 9.343958 | 999 | 10.656042 | 10.010335 | 10.666376 | 33 |
| 28 | 9.334195 | 952 | 9.989637 | 45 | 9.344558 | 998 | 10.655442 | 10.010363 | 10.665805 | 32 |
| 29 | 9.334767 | 950 | 9.989610 | 47 | 9.345157 | 997 | 10.654843 | 10.010390 | 10.665233 | 31 |
| 30 | 9.335337 | 949 | 9.989582 | 48 | 9.345755 | 996 | 10.654245 | 10.010418 | 10.664663 | 30 |
| 31 | 9.335906 | 948 | 9.989553 | 47 | 9.346353 | 994 | 10.653647 | 10.010447 | 10.664094 | 29 |
| 32 | 9.336475 | 946 | 9.989525 | 47 | 9.346949 | 993 | 10.653051 | 10.010475 | 10.663525 | 28 |
| 33 | 9.337043 | 945 | 9.989497 | 47 | 9.347545 | 992 | 10.652455 | 10.010503 | 10.662957 | 27 |
| 34 | 9.337610 | 944 | 9.989469 | 47 | 9.348141 | 991 | 10.651859 | 10.010531 | 10.662390 | 26 |
| 35 | 9.338176 | 943 | 9.989441 | 47 | 9.348735 | 990 | 10.651265 | 10.010559 | 10.661824 | 25 |
| 36 | 9.338742 | 941 | 9.989413 | 47 | 9.349329 | 988 | 10.650671 | 10.010587 | 10.661258 | 24 |
| 37 | 9.339307 | 940 | 9.989385 | 48 | 9.349922 | 987 | 10.650078 | 10.010615 | 10.660693 | 23 |
| 38 | 9.339871 | 939 | 9.989356 | 47 | 9.350514 | 986 | 10.649486 | 10.010644 | 10.660129 | 22 |
| 39 | 9.340434 | 937 | 9.989328 | 47 | 9.351106 | 985 | 10.648894 | 10.010672 | 10.659566 | 21 |
| 40 | 9.340996 | 936 | 9.989300 | 48 | 9.351697 | 983 | 10.648303 | 10.010700 | 10.659004 | 20 |
| 41 | 9.341558 | 935 | 9.989271 | 47 | 9.352287 | 982 | 10.647713 | 10.010729 | 10.658442 | 19 |
| 42 | 9.342119 | 934 | 9.989243 | 48 | 9.352876 | 981 | 10.647124 | 10.010757 | 10.657881 | 18 |
| 43 | 9.342679 | 932 | 9.989214 | 47 | 9.353465 | 980 | 10.646535 | 10.010786 | 10.657321 | 17 |
| 44 | 9.343239 | 931 | 9.989186 | 48 | 9.354053 | 979 | 10.645947 | 10.010814 | 10.656761 | 16 |
| 45 | 9.343797 | 930 | 9.989157 | 48 | 9.354640 | 977 | 10.645360 | 10.010843 | 10.656203 | 15 |
| 46 | 9.344355 | 929 | 9.989128 | 47 | 9.355227 | 976 | 10.644773 | 10.010872 | 10.655645 | 14 |
| 47 | 9.344912 | 927 | 9.989100 | 48 | 9.355813 | 975 | 10.644187 | 10.010900 | 10.655088 | 13 |
| 48 | 9.345469 | 926 | 9.989071 | 48 | 9.356398 | 974 | 10.643602 | 10.010929 | 10.654531 | 12 |
| 49 | 9.346024 | 925 | 9.989042 | 47 | 9.356982 | 973 | 10.643018 | 10.010958 | 10.653976 | 11 |
| 50 | 9.346579 | 924 | 9.989014 | 48 | 9.357566 | 971 | 10.642434 | 10.010986 | 10.653421 | 10 |
| 51 | 9.347134 | 922 | 9.988985 | 48 | 9.358149 | 970 | 10.641851 | 10.011015 | 10.652866 | 9 |
| 52 | 9.347687 | 921 | 9.988956 | 48 | 9.358731 | 969 | 10.641269 | 10.011044 | 10.652313 | 8 |
| 53 | 9.348240 | 920 | 9.988927 | 48 | 9.359313 | 968 | 10.640687 | 10.011073 | 10.651760 | 7 |
| 54 | 9.348792 | 919 | 9.988898 | 48 | 9.359893 | 967 | 10.640107 | 10.011102 | 10.651208 | 6 |
| 55 | 9.349343 | 917 | 9.988869 | 48 | 9.360474 | 966 | 10.639526 | 10.011131 | 10.650657 | 5 |
| 56 | 9.349893 | 916 | 9.988840 | 48 | 9.361053 | 965 | 10.638947 | 10.011160 | 10.650107 | 4 |
| 57 | 9.350443 | 915 | 9.988811 | 48 | 9.361632 | 963 | 10.638368 | 10.011189 | 10.649557 | 3 |
| 58 | 9.350992 | 914 | 9.988782 | 48 | 9.362210 | 962 | 10.637790 | 10.011218 | 10.649008 | 2 |
| 59 | 9.351540 | 913 | 9.988753 | 48 | 9.362787 | 961 | 10.637213 | 10.011247 | 10.648460 | 1 |
| 60 | 9.352088 | | 9.988724 | | 9.363364 | | 10.636636 | 10.011276 | 10.647912 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

### 77 Degrees.

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13 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.352088 | 911 | 9.988724 | 48 | 9.363364 | 960 | 10.636636 | 10.011276 | 10.647912 | 60 |
| 1 | 9.352635 | 910 | 9.988695 | 48 | 9.363940 | 959 | 10.636060 | 10.011305 | 10.647365 | 59 |
| 2 | 9.353181 | 909 | 9.988666 | 50 | 9.364515 | 958 | 10.635485 | 10.011334 | 10.646819 | 58 |
| 3 | 9.353726 | 908 | 9.988636 | 48 | 9.365090 | 957 | 10.634910 | 10.011364 | 10.646274 | 57 |
| 4 | 9.354271 | 907 | 9.988607 | 48 | 9.365664 | 955 | 10.634336 | 10.011393 | 10.645729 | 56 |
| 5 | 9.354815 | 905 | 9.988578 | 50 | 9.366237 | 954 | 10.633763 | 10.011422 | 10.645185 | 55 |
| 6 | 9.355358 | 904 | 9.988548 | 48 | 9.366810 | 953 | 10.633190 | 10.011452 | 10.644642 | 54 |
| 7 | 9.355901 | 903 | 9.988519 | 50 | 9.367382 | 952 | 10.632618 | 10.011481 | 10.644099 | 53 |
| 8 | 9.356443 | 902 | 9.988489 | 48 | 9.367953 | 951 | 10.632047 | 10.011511 | 10.643557 | 52 |
| 9 | 9.356984 | 901 | 9.988460 | 50 | 9.368524 | 950 | 10.631476 | 10.011540 | 10.643016 | 51 |
| 10 | 9.357524 | 899 | 9.988430 | 48 | 9.369094 | 949 | 10.630906 | 10.011570 | 10.642476 | 50 |
| 11 | 9.358064 | 898 | 9.988401 | 50 | 9.369663 | 948 | 10.630337 | 10.011599 | 10.641936 | 49 |
| 12 | 9.358603 | 897 | 9.988371 | 48 | 9.370232 | 946 | 10.629768 | 10.011629 | 10.641397 | 48 |
| 13 | 9.359141 | 896 | 9.988342 | 50 | 9.370799 | 945 | 10.629201 | 10.011658 | 10.640859 | 47 |
| 14 | 9.359678 | 895 | 9.988312 | 50 | 9.371367 | 944 | 10.628633 | 10.011688 | 10.640322 | 46 |
| 15 | 9.360215 | 893 | 9.988282 | 50 | 9.371933 | 943 | 10.628067 | 10.011718 | 10.639785 | 45 |
| 16 | 9.360752 | 892 | 9.988252 | 48 | 9.372499 | 942 | 10.627501 | 10.011748 | 10.639248 | 44 |
| 17 | 9.361287 | 891 | 9.988223 | 50 | 9.373064 | 941 | 10.626936 | 10.011777 | 10.638713 | 43 |
| 18 | 9.361822 | 890 | 9.988193 | 50 | 9.373629 | 940 | 10.626371 | 10.011807 | 10.638178 | 42 |
| 19 | 9.362356 | 889 | 9.988163 | 50 | 9.374193 | 939 | 10.625807 | 10.011837 | 10.637644 | 41 |
| 20 | 9.362889 | 888 | 9.988133 | 50 | 9.374756 | 938 | 10.625244 | 10.011867 | 10.637111 | 40 |
| 21 | 9.363422 | 887 | 9.988103 | 50 | 9.375319 | 937 | 10.624681 | 10.011897 | 10.636578 | 39 |
| 22 | 9.363954 | 885 | 9.988073 | 50 | 9.375881 | 935 | 10.624119 | 10.011927 | 10.636046 | 38 |
| 23 | 9.364485 | 884 | 9.988043 | 50 | 9.376442 | 934 | 10.623558 | 10.011957 | 10.635515 | 37 |
| 24 | 9.365016 | 883 | 9.988013 | 50 | 9.377003 | 933 | 10.622997 | 10.011987 | 10.634984 | 36 |
| 25 | 9.365546 | 882 | 9.987983 | 50 | 9.377563 | 932 | 10.622437 | 10.012017 | 10.634454 | 35 |
| 26 | 9.366075 | 881 | 9.987953 | 52 | 9.378122 | 931 | 10.621878 | 10.012047 | 10.633925 | 34 |
| 27 | 9.366604 | 880 | 9.987922 | 50 | 9.378681 | 930 | 10.621319 | 10.012078 | 10.633396 | 33 |
| 28 | 9.367131 | 879 | 9.987892 | 50 | 9.379239 | 929 | 10.620761 | 10.012108 | 10.632869 | 32 |
| 29 | 9.367659 | 878 | 9.987862 | 50 | 9.379797 | 928 | 10.620203 | 10.012138 | 10.632341 | 31 |
| 30 | 9.368185 | 876 | 9.987832 | 52 | 9.380354 | 927 | 10.619646 | 10.012168 | 10.631815 | 30 |
| 31 | 9.368711 | 875 | 9.987801 | 50 | 9.380910 | 926 | 10.619090 | 10.012199 | 10.631289 | 29 |
| 32 | 9.369236 | 874 | 9.987771 | 52 | 9.381466 | 925 | 10.618534 | 10.012229 | 10.630764 | 28 |
| 33 | 9.369761 | 873 | 9.987740 | 50 | 9.382020 | 924 | 10.617980 | 10.012260 | 10.630239 | 27 |
| 34 | 9.370285 | 872 | 9.987710 | 52 | 9.382575 | 923 | 10.617425 | 10.012290 | 10.629715 | 26 |
| 35 | 9.370808 | 871 | 9.987679 | 50 | 9.383129 | 922 | 10.616871 | 10.012321 | 10.629192 | 25 |
| 36 | 9.371330 | 870 | 9.987649 | 52 | 9.383682 | 921 | 10.616318 | 10.012351 | 10.628670 | 24 |
| 37 | 9.371852 | 869 | 9.987618 | 50 | 9.384234 | 920 | 10.615766 | 10.012382 | 10.628148 | 23 |
| 38 | 9.372373 | 867 | 9.987588 | 52 | 9.384786 | 919 | 10.615214 | 10.012412 | 10.627627 | 22 |
| 39 | 9.372894 | 866 | 9.987557 | 52 | 9.385337 | 918 | 10.614663 | 10.012443 | 10.627106 | 21 |
| 40 | 9.373414 | 865 | 9.987526 | 50 | 9.385888 | 917 | 10.614112 | 10.012474 | 10.626586 | 20 |
| 41 | 9.373933 | 864 | 9.987496 | 52 | 9.386438 | 916 | 10.613562 | 10.012504 | 10.626067 | 19 |
| 42 | 9.374452 | 863 | 9.987465 | 52 | 9.386987 | 914 | 10.613013 | 10.012535 | 10.625548 | 18 |
| 43 | 9.374970 | 862 | 9.987434 | 52 | 9.387536 | 913 | 10.612464 | 10.012566 | 10.625030 | 17 |
| 44 | 9.375487 | 861 | 9.987403 | 52 | 9.388084 | 912 | 10.611916 | 10.012597 | 10.624513 | 16 |
| 45 | 9.376003 | 860 | 9.987372 | 52 | 9.388631 | 911 | 10.611369 | 10.012628 | 10.623997 | 15 |
| 46 | 9.376519 | 859 | 9.987341 | 52 | 9.389178 | 910 | 10.610822 | 10.012659 | 10.623481 | 14 |
| 47 | 9.377035 | 858 | 9.987310 | 52 | 9.389724 | 909 | 10.610276 | 10.012690 | 10.622965 | 13 |
| 48 | 9.377549 | 857 | 9.987279 | 52 | 9.390270 | 908 | 10.609730 | 10.012721 | 10.622451 | 12 |
| 49 | 9.378063 | 856 | 9.987248 | 52 | 9.390815 | 907 | 10.609185 | 10.012752 | 10.621937 | 11 |
| 50 | 9.378577 | 854 | 9.987217 | 52 | 9.391360 | 906 | 10.608640 | 10.012783 | 10.621423 | 10 |
| 51 | 9.379089 | 853 | 9.987186 | 52 | 9.391903 | 905 | 10.608097 | 10.012814 | 10.620911 | 9 |
| 52 | 9.379601 | 852 | 9.987155 | 52 | 9.392447 | 904 | 10.607553 | 10.012845 | 10.620399 | 8 |
| 53 | 9.380113 | 851 | 9.987124 | 53 | 9.392989 | 903 | 10.607011 | 10.012876 | 10.619887 | 7 |
| 54 | 9.380624 | 850 | 9.987092 | 52 | 9.393531 | 902 | 10.606469 | 10.012908 | 10.619376 | 6 |
| 55 | 9.381134 | 849 | 9.987061 | 52 | 9.394073 | 901 | 10.605927 | 10.012939 | 10.618866 | 5 |
| 56 | 9.381643 | 848 | 9.987030 | 53 | 9.394614 | 900 | 10.605386 | 10.012970 | 10.618357 | 4 |
| 57 | 9.382152 | 847 | 9.986998 | 52 | 9.395154 | 899 | 10.604846 | 10.013002 | 10.617848 | 3 |
| 58 | 9.382661 | 846 | 9.986967 | 52 | 9.395694 | 898 | 10.604306 | 10.013033 | 10.617339 | 2 |
| 59 | 9.383168 | 845 | 9.986936 | 53 | 9.396233 | 897 | 10.603767 | 10.013064 | 10.616832 | 1 |
| 60 | 9.383675 | | 9.986904 | | 9.396771 | | 10.603229 | 10.013096 | 10.616325 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

76 Degrees.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

14 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.383675 | 844 | 9.986904 | 52 | 9.396771 | 896 | 10.603229 | 10.013096 | 10.616325 | 60 |
| 1 | 9.384182 | 843 | 9.986873 | 53 | 9.397309 | 896 | 10.602691 | 10.013127 | 10.615818 | 59 |
| 2 | 9.384687 | 842 | 9.986841 | 53 | 9.397846 | 895 | 10.602154 | 10.013159 | 10.615313 | 58 |
| 3 | 9.385192 | 841 | 9.986809 | 52 | 9.398383 | 894 | 10.601617 | 10.013191 | 10.614808 | 57 |
| 4 | 9.385697 | 840 | 9.986778 | 53 | 9.398919 | 893 | 10.601081 | 10.013222 | 10.614303 | 56 |
| 5 | 9.386201 | 839 | 9.986746 | 53 | 9.399455 | 892 | 10.600545 | 10.013254 | 10.613799 | 55 |
| 6 | 9.386704 | 838 | 9.986714 | 53 | 9.399990 | 891 | 10.600010 | 10.013286 | 10.613296 | 54 |
| 7 | 9.387207 | 837 | 9.986683 | 52 | 9.400524 | 890 | 10.599476 | 10.013317 | 10.612793 | 53 |
| 8 | 9.387709 | 836 | 9.986651 | 53 | 9.401058 | 889 | 10.598942 | 10.013349 | 10.612291 | 52 |
| 9 | 9.388210 | 835 | 9.986619 | 53 | 9.401591 | 888 | 10.598409 | 10.013381 | 10.611790 | 51 |
| 10 | 9.388711 | 834 | 9.986587 | 53 | 9.402124 | 887 | 10.597876 | 10.013413 | 10.611289 | 50 |
| 11 | 9.389211 | 833 | 9.986555 | 53 | 9.402656 | 886 | 10.597344 | 10.013445 | 10.610789 | 49 |
| 12 | 9.389711 | 832 | 9.986523 | 53 | 9.403187 | 885 | 10.596813 | 10.013477 | 10.610289 | 48 |
| 13 | 9.390210 | 831 | 9.986491 | 53 | 9.403718 | 884 | 10.596282 | 10.013509 | 10.609790 | 47 |
| 14 | 9.390708 | 830 | 9.986459 | 53 | 9.404249 | 883 | 10.595751 | 10.013541 | 10.609292 | 46 |
| 15 | 9.391206 | 828 | 9.986427 | 53 | 9.404778 | 882 | 10.595222 | 10.013573 | 10.608794 | 45 |
| 16 | 9.391703 | 827 | 9.986395 | 53 | 9.405308 | 881 | 10.594692 | 10.013605 | 10.608297 | 44 |
| 17 | 9.392199 | 826 | 9.986363 | 53 | 9.405836 | 880 | 10.594164 | 10.013637 | 10.607801 | 43 |
| 18 | 9.392695 | 825 | 9.986331 | 53 | 9.406364 | 879 | 10.593636 | 10.013669 | 10.607305 | 42 |
| 19 | 9.393191 | 824 | 9.986299 | 55 | 9.406892 | 878 | 10.593108 | 10.013701 | 10.606810 | 41 |
| 20 | 9.393685 | 823 | 9.986266 | 53 | 9.407419 | 877 | 10.592581 | 10.013734 | 10.606315 | 40 |
| 21 | 9.394179 | 822 | 9.986234 | 53 | 9.407945 | 876 | 10.592055 | 10.013766 | 10.605821 | 39 |
| 22 | 9.394673 | 821 | 9.986202 | 55 | 9.408471 | 875 | 10.591529 | 10.013798 | 10.605327 | 38 |
| 23 | 9.395166 | 820 | 9.986169 | 53 | 9.408997 | 874 | 10.591003 | 10.013831 | 10.604834 | 37 |
| 24 | 9.395658 | 819 | 9.986137 | 55 | 9.409521 | 874 | 10.590479 | 10.013863 | 10.604342 | 36 |
| 25 | 9.396150 | 818 | 9.986104 | 53 | 9.410045 | 873 | 10.589955 | 10.013896 | 10.603850 | 35 |
| 26 | 9.396641 | 817 | 9.986072 | 55 | 9.410569 | 872 | 10.589431 | 10.013928 | 10.603359 | 34 |
| 27 | 9.397132 | 817 | 9.986039 | 53 | 9.411092 | 871 | 10.588908 | 10.013961 | 10.602868 | 33 |
| 28 | 9.397621 | 816 | 9.986007 | 55 | 9.411615 | 870 | 10.588385 | 10.013993 | 10.602379 | 32 |
| 29 | 9.398111 | 815 | 9.985974 | 53 | 9.412137 | 869 | 10.587863 | 10.014026 | 10.601889 | 31 |
| 30 | 9.398600 | 814 | 9.985942 | 55 | 9.412658 | 868 | 10.587342 | 10.014058 | 10.601400 | 30 |
| 31 | 9.399088 | 813 | 9.985909 | 55 | 9.413179 | 867 | 10.586821 | 10.014091 | 10.600912 | 29 |
| 32 | 9.399575 | 812 | 9.985876 | 55 | 9.413699 | 866 | 10.586301 | 10.014124 | 10.600425 | 28 |
| 33 | 9.400062 | 811 | 9.985843 | 53 | 9.414219 | 865 | 10.585781 | 10.014157 | 10.599938 | 27 |
| 34 | 9.400549 | 810 | 9.985811 | 55 | 9.414738 | 864 | 10.585262 | 10.014189 | 10.599451 | 26 |
| 35 | 9.401035 | 809 | 9.985778 | 55 | 9.415257 | 864 | 10.584743 | 10.014222 | 10.598965 | 25 |
| 36 | 9.401520 | 808 | 9.985745 | 55 | 9.415775 | 863 | 10.584225 | 10.014255 | 10.598480 | 24 |
| 37 | 9.402005 | 807 | 9.985712 | 55 | 9.416293 | 862 | 10.583707 | 10.014288 | 10.597995 | 23 |
| 38 | 9.402489 | 806 | 9.985679 | 55 | 9.416810 | 861 | 10.583190 | 10.014321 | 10.597511 | 22 |
| 39 | 9.402972 | 805 | 9.985646 | 55 | 9.417326 | 860 | 10.582674 | 10.014354 | 10.597028 | 21 |
| 40 | 9.403455 | 804 | 9.985613 | 55 | 9.417842 | 859 | 10.582158 | 10.014387 | 10.596545 | 20 |
| 41 | 9.403938 | 803 | 9.985580 | 55 | 9.418358 | 858 | 10.581642 | 10.014420 | 10.596062 | 19 |
| 42 | 9.404420 | 802 | 9.985547 | 55 | 9.418873 | 857 | 10.581127 | 10.014453 | 10.595580 | 18 |
| 43 | 9.404901 | 801 | 9.985514 | 57 | 9.419387 | 856 | 10.580613 | 10.014486 | 10.595099 | 17 |
| 44 | 9.405382 | 800 | 9.985480 | 55 | 9.419901 | 855 | 10.580099 | 10.014520 | 10.594618 | 16 |
| 45 | 9.405862 | 799 | 9.985447 | 55 | 9.420415 | 855 | 10.579585 | 10.014553 | 10.594138 | 15 |
| 46 | 9.406341 | 798 | 9.985414 | 55 | 9.420927 | 854 | 10.579073 | 10.014586 | 10.593659 | 14 |
| 47 | 9.406820 | 797 | 9.985381 | 57 | 9.421440 | 853 | 10.578560 | 10.014619 | 10.593180 | 13 |
| 48 | 9.407299 | 796 | 9.985347 | 55 | 9.421952 | 852 | 10.578048 | 10.014653 | 10.592701 | 12 |
| 49 | 9.407777 | 795 | 9.985314 | 57 | 9.422463 | 851 | 10.577537 | 10.014686 | 10.592223 | 11 |
| 50 | 9.408254 | 794 | 9.985280 | 55 | 9.422974 | 850 | 10.577026 | 10.014720 | 10.591746 | 10 |
| 51 | 9.408731 | 794 | 9.985247 | 57 | 9.423484 | 849 | 10.576516 | 10.014753 | 10.591269 | 9 |
| 52 | 9.409207 | 793 | 9.985213 | 55 | 9.423993 | 848 | 10.576007 | 10.014787 | 10.590793 | 8 |
| 53 | 9.409682 | 792 | 9.985180 | 57 | 9.424503 | 848 | 10.575497 | 10.014820 | 10.590318 | 7 |
| 54 | 9.410157 | 791 | 9.985146 | 55 | 9.425011 | 847 | 10.574989 | 10.014854 | 10.589843 | 6 |
| 55 | 9.410632 | 790 | 9.985113 | 57 | 9.425519 | 846 | 10.574481 | 10.014887 | 10.589368 | 5 |
| 56 | 9.411106 | 789 | 9.985079 | 57 | 9.426027 | 845 | 10.573973 | 10.014921 | 10.588894 | 4 |
| 57 | 9.411579 | 788 | 9.985045 | 57 | 9.426534 | 844 | 10.573466 | 10.014955 | 10.588421 | 3 |
| 58 | 9.412052 | 787 | 9.985011 | 55 | 9.427041 | 843 | 10.572959 | 10.014989 | 10.587948 | 2 |
| 59 | 9.412524 | 786 | 9.984978 | 57 | 9.427547 | 843 | 10.572453 | 10.015022 | 10.587476 | 1 |
| 60 | 9.412996 | | 9.984944 | | 9.428052 | | 10.571948 | 10.015056 | 10.587004 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

75 Degrees.

15 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.412996 | 785 | 9.984944 | 57 | 9.428052 | 842 | 10.571948 | 10.015056 | 10.587004 | 60 |
| 1 | 9.413467 | 784 | 9.984910 | 57 | 9.428557 | 841 | 10.571443 | 10.015090 | 10.586533 | 59 |
| 2 | 9.413938 | 783 | 9.984876 | 57 | 9.429062 | 840 | 10.570938 | 10.015124 | 10.586062 | 58 |
| 3 | 9.414408 | 783 | 9.984842 | 57 | 9.429566 | 839 | 10.570434 | 10.015158 | 10.585592 | 57 |
| 4 | 9.414878 | 782 | 9.984808 | 57 | 9.430070 | 838 | 10.569930 | 10.015192 | 10.585122 | 56 |
| 5 | 9.415347 | 781 | 9.984774 | 57 | 9.430573 | 838 | 10.569427 | 10.015226 | 10.584653 | 55 |
| 6 | 9.415815 | 780 | 9.984740 | 57 | 9.431075 | 837 | 10.568925 | 10.015260 | 10.584185 | 54 |
| 7 | 9.416283 | 779 | 9.984706 | 57 | 9.431577 | 836 | 10.568423 | 10.015294 | 10.583717 | 53 |
| 8 | 9.416751 | 778 | 9.984672 | 57 | 9.432079 | 835 | 10.567921 | 10.015328 | 10.583249 | 52 |
| 9 | 9.417217 | 777 | 9.984638 | 58 | 9.432580 | 834 | 10.567420 | 10.015362 | 10.582783 | 51 |
| 10 | 9.417684 | 776 | 9.984603 | 57 | 9.433080 | 833 | 10.566920 | 10.015397 | 10.582316 | 50 |
| 11 | 9.418150 | 775 | 9.984569 | 57 | 9.433580 | 832 | 10.566420 | 10.015431 | 10.581850 | 49 |
| 12 | 9.418615 | 774 | 9.984535 | 58 | 9.434080 | 832 | 10.565920 | 10.015465 | 10.581385 | 48 |
| 13 | 9.419079 | 773 | 9.984500 | 57 | 9.434579 | 831 | 10.565421 | 10.015500 | 10.580921 | 47 |
| 14 | 9.419544 | 773 | 9.984466 | 57 | 9.435078 | 830 | 10.564922 | 10.015534 | 10.580456 | 46 |
| 15 | 9.420007 | 772 | 9.984432 | 58 | 9.435576 | 829 | 10.564424 | 10.015568 | 10.579993 | 45 |
| 16 | 9.420470 | 771 | 9.984397 | 57 | 9.436073 | 828 | 10.563927 | 10.015603 | 10.579530 | 44 |
| 17 | 9.420933 | 770 | 9.984363 | 58 | 9.436570 | 828 | 10.563430 | 10.015637 | 10.579067 | 43 |
| 18 | 9.421395 | 769 | 9.984328 | 58 | 9.437067 | 827 | 10.562933 | 10.015672 | 10.578605 | 42 |
| 19 | 9.421857 | 768 | 9.984294 | 57 | 9.437563 | 826 | 10.562437 | 10.015706 | 10.578143 | 41 |
| 20 | 9.422318 | 767 | 9.984259 | 58 | 9.438059 | 825 | 10.561941 | 10.015741 | 10.577682 | 40 |
| 21 | 9.422778 | 767 | 9.984224 | 57 | 9.438554 | 824 | 10.561446 | 10.015776 | 10.577222 | 39 |
| 22 | 9.423238 | 766 | 9.984190 | 58 | 9.439048 | 823 | 10.560952 | 10.015810 | 10.576762 | 38 |
| 23 | 9.423697 | 765 | 9.984155 | 58 | 9.439543 | 823 | 10.560457 | 10.015845 | 10.576303 | 37 |
| 24 | 9.424156 | 764 | 9.984120 | 58 | 9.440036 | 822 | 10.559964 | 10.015880 | 10.575844 | 36 |
| 25 | 9.424615 | 763 | 9.984085 | 58 | 9.440529 | 821 | 10.559471 | 10.015915 | 10.575385 | 35 |
| 26 | 9.425073 | 762 | 9.984050 | 58 | 9.441022 | 820 | 10.558978 | 10.015950 | 10.574927 | 34 |
| 27 | 9.425530 | 761 | 9.984015 | 57 | 9.441514 | 819 | 10.558486 | 10.015985 | 10.574470 | 33 |
| 28 | 9.425987 | 760 | 9.983981 | 58 | 9.442006 | 819 | 10.557994 | 10.016019 | 10.574013 | 32 |
| 29 | 9.426443 | 760 | 9.983946 | 58 | 9.442497 | 818 | 10.557503 | 10.016054 | 10.573557 | 31 |
| 30 | 9.426899 | 759 | 9.983911 | 60 | 9.442988 | 817 | 10.557012 | 10.016089 | 10.573101 | 30 |
| 31 | 9.427354 | 758 | 9.983875 | 58 | 9.443479 | 816 | 10.556521 | 10.016125 | 10.572646 | 29 |
| 32 | 9.427809 | 757 | 9.983840 | 58 | 9.443968 | 816 | 10.556032 | 10.016160 | 10.572191 | 28 |
| 33 | 9.428263 | 756 | 9.983805 | 58 | 9.444458 | 815 | 10.555542 | 10.016195 | 10.571737 | 27 |
| 34 | 9.428717 | 755 | 9.983770 | 58 | 9.444947 | 814 | 10.555053 | 10.016230 | 10.571283 | 26 |
| 35 | 9.429170 | 754 | 9.983735 | 58 | 9.445435 | 813 | 10.554565 | 10.016265 | 10.570830 | 25 |
| 36 | 9.429623 | 753 | 9.983700 | 60 | 9.445923 | 812 | 10.554077 | 10.016300 | 10.570377 | 24 |
| 37 | 9.430075 | 752 | 9.983664 | 58 | 9.446411 | 812 | 10.553589 | 10.016336 | 10.569925 | 23 |
| 38 | 9.430527 | 752 | 9.983629 | 58 | 9.446898 | 811 | 10.553102 | 10.016371 | 10.569473 | 22 |
| 39 | 9.430978 | 751 | 9.983594 | 60 | 9.447384 | 810 | 10.552616 | 10.016406 | 10.569022 | 21 |
| 40 | 9.431429 | 750 | 9.983558 | 58 | 9.447870 | 809 | 10.552130 | 10.016442 | 10.568571 | 20 |
| 41 | 9.431879 | 749 | 9.983523 | 60 | 9.448356 | 809 | 10.551644 | 10.016477 | 10.568121 | 19 |
| 42 | 9.432329 | 749 | 9.983487 | 58 | 9.448841 | 808 | 10.551159 | 10.016513 | 10.567671 | 18 |
| 43 | 9.432778 | 748 | 9.983452 | 60 | 9.449326 | 807 | 10.550674 | 10.016548 | 10.567222 | 17 |
| 44 | 9.433226 | 747 | 9.983416 | 58 | 9.449810 | 806 | 10 550190 | 10.016584 | 10.566774 | 16 |
| 45 | 9.433675 | 746 | 9.983381 | 60 | 9.450294 | 806 | 10.549706 | 10.016619 | 10.566325 | 15 |
| 46 | 9.434122 | 745 | 9.983345 | 60 | 9.450777 | 805 | 10.549223 | 10.016655 | 10.565878 | 14 |
| 47 | 9.434569 | 744 | 9.983309 | 60 | 9.451260 | 804 | 10.548740 | 10.016691 | 10.565431 | 13 |
| 48 | 9.435016 | 744 | 9.983273 | 58 | 9.451743 | 803 | 10.548257 | 10.016727 | 10.564984 | 12 |
| 49 | 9.435462 | 743 | 9.983238 | 60 | 9.452225 | 802 | 10.547775 | 10.016762 | 10.564538 | 11 |
| 50 | 9.435908 | 742 | 9.983202 | 60 | 9.452706 | 802 | 10.547294 | 10.016798 | 10.564092 | 10 |
| 51 | 9.436353 | 741 | 9.983166 | 60 | 9.453187 | 801 | 10.546813 | 10.016834 | 10.563647 | 9 |
| 52 | 9.436798 | 740 | 9.983130 | 60 | 9.453668 | 800 | 10.546332 | 10.016870 | 10.563202 | 8 |
| 53 | 9.437242 | 740 | 9.983094 | 60 | 9.454148 | 799 | 10.545852 | 10.016906 | 10.562758 | 7 |
| 54 | 9.437686 | 739 | 9.983058 | 60 | 9.454628 | 799 | 10.545372 | 10.016942 | 10.562314 | 6 |
| 55 | 9.438129 | 738 | 9.983022 | 60 | 9.455107 | 798 | 10.544893 | 10.016978 | 10.561871 | 5 |
| 56 | 9.438572 | 737 | 9.982986 | 60 | 9.455586 | 797 | 10.544414 | 10.017014 | 10.561428 | 4 |
| 57 | 9.439014 | 736 | 9.982950 | 60 | 9.456064 | 796 | 10.543936 | 10.017050 | 10.560986 | 3 |
| 58 | 9.439456 | 736 | 9.982914 | 60 | 9.456542 | 796 | 10.543458 | 10.017086 | 10.560544 | 2 |
| 59 | 9.439897 | 735 | 9.982878 | 60 | 9.457019 | 795 | 10.542981 | 10.017122 | 10.560103 | 1 |
| 60 | 9.440338 | | 9.982842 | | 9.457496 | | 10.542504 | 10.017158 | 10.559662 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

74 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 16 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.440338 | 734 | 9.982842 | 62 | 9.457496 | 794 | 10.542504 | 10.017158 | 10.559662 | 60 |
| 1 | 9.440778 | 733 | 9.982805 | 60 | 9.457973 | 793 | 10.542027 | 10.017195 | 10.559222 | 59 |
| 2 | 9.441218 | 732 | 9.982769 | 60 | 9.458449 | 793 | 10.541551 | 10.017231 | 10.558782 | 58 |
| 3 | 9.441658 | 731 | 9.982733 | 62 | 9.458925 | 792 | 10.541075 | 10.017267 | 10.558342 | 57 |
| 4 | 9.442096 | 731 | 9.982696 | 60 | 9.459400 | 791 | 10.540600 | 10.017304 | 10.557904 | 56 |
| 5 | 9.442535 | 730 | 9.982660 | 60 | 9.459875 | 790 | 10.540125 | 10.017340 | 10.557465 | 55 |
| 6 | 9.442973 | 729 | 9.982624 | 62 | 9.460349 | 790 | 10.539651 | 10.017376 | 10.557027 | 54 |
| 7 | 9.443410 | 728 | 9.982587 | 60 | 9.460823 | 789 | 10.539177 | 10.017413 | 10.556590 | 53 |
| 8 | 9.443847 | 727 | 9.982551 | 62 | 9.461297 | 788 | 10.538703 | 10.017449 | 10.556153 | 52 |
| 9 | 9.444284 | 727 | 9.982514 | 62 | 9.461770 | 788 | 10.538230 | 10.017486 | 10.555716 | 51 |
| 10 | 9.444720 | 726 | 9.982477 | 60 | 9.462242 | 787 | 10.537758 | 10.017523 | 10.555280 | 50 |
| 11 | 9.445155 | 725 | 9.982441 | 62 | 9.462714 | 786 | 10.537286 | 10.017559 | 10.554845 | 49 |
| 12 | 9.445590 | 724 | 9.982404 | 62 | 9.463186 | 785 | 10.536814 | 10.017596 | 10.554410 | 48 |
| 13 | 9.446025 | 723 | 9.982367 | 60 | 9.463658 | 785 | 10.536342 | 10.017633 | 10.553975 | 47 |
| 14 | 9.446459 | 723 | 9.982331 | 62 | 9.464128 | 784 | 10.535872 | 10.017669 | 10.553541 | 46 |
| 15 | 9.446893 | 722 | 9.982294 | 62 | 9.464599 | 783 | 10.535401 | 10.017706 | 10.553107 | 45 |
| 16 | 9.447326 | 721 | 9.982257 | 62 | 9.465069 | 783 | 10.534931 | 10.017743 | 10.552674 | 44 |
| 17 | 9.447759 | 720 | 9.982220 | 62 | 9.465539 | 782 | 10.534461 | 10.017780 | 10.552241 | 43 |
| 18 | 9.448191 | 720 | 9.982183 | 62 | 9.466008 | 781 | 10.533992 | 10.017817 | 10.551809 | 42 |
| 19 | 9.448623 | 719 | 9.982146 | 62 | 9.466476 | 780 | 10.533524 | 10.017854 | 10.551377 | 41 |
| 20 | 9.449054 | 718 | 9.982109 | 62 | 9.466945 | 780 | 10.533055 | 10.017891 | 10.550946 | 40 |
| 21 | 9.449485 | 717 | 9.982072 | 62 | 9.467413 | 779 | 10.532587 | 10.017928 | 10.550515 | 39 |
| 22 | 9.449915 | 716 | 9.982035 | 62 | 9.467880 | 778 | 10.532120 | 10.017965 | 10.550085 | 38 |
| 23 | 9.450345 | 716 | 9.981998 | 62 | 9.468347 | 778 | 10.531653 | 10.018002 | 10.549655 | 37 |
| 24 | 9.450775 | 715 | 9.981961 | 62 | 9.468814 | 777 | 10.531186 | 10.018039 | 10.549225 | 36 |
| 25 | 9.451204 | 714 | 9.981924 | 63 | 9.469280 | 776 | 10.530720 | 10.018076 | 10.548796 | 35 |
| 26 | 9.451632 | 713 | 9.981886 | 62 | 9.469746 | 775 | 10.530254 | 10.018114 | 10.548368 | 34 |
| 27 | 9.452060 | 713 | 9.981849 | 62 | 9.470211 | 775 | 10.529789 | 10.018151 | 10.547940 | 33 |
| 28 | 9.452488 | 712 | 9.981812 | 63 | 9.470676 | 774 | 10.529324 | 10.018188 | 10.547512 | 32 |
| 29 | 9.452915 | 711 | 9.981774 | 62 | 9.471141 | 773 | 10.528859 | 10.018226 | 10.547085 | 31 |
| 30 | 9.453342 | 710 | 9.981737 | 62 | 9.471605 | 773 | 10.528395 | 10.018263 | 10.546658 | 30 |
| 31 | 9.453768 | 710 | 9.981700 | 63 | 9.472068 | 772 | 10.527932 | 10.018300 | 10.546232 | 29 |
| 32 | 9.454194 | 709 | 9.981662 | 62 | 9.472532 | 771 | 10.527468 | 10.018338 | 10.545806 | 28 |
| 33 | 9.454619 | 708 | 9.981625 | 63 | 9.472995 | 771 | 10.527005 | 10.018375 | 10.545381 | 27 |
| 34 | 9.455044 | 707 | 9.981587 | 63 | 9.473457 | 770 | 10.526543 | 10.018413 | 10.544956 | 26 |
| 35 | 9.455469 | 707 | 9.981549 | 62 | 9.473919 | 769 | 10.526081 | 10.018451 | 10.544531 | 25 |
| 36 | 9.455893 | 706 | 9.981512 | 63 | 9.474381 | 769 | 10.525619 | 10.018488 | 10.544107 | 24 |
| 37 | 9.456316 | 705 | 9.981474 | 63 | 9.474842 | 768 | 10.525158 | 10.018526 | 10.543684 | 23 |
| 38 | 9.456739 | 704 | 9.981436 | 62 | 9.475303 | 767 | 10.524697 | 10.018564 | 10.543261 | 22 |
| 39 | 9.457162 | 704 | 9.981399 | 63 | 9.475763 | 767 | 10.524237 | 10.018601 | 10.542838 | 21 |
| 40 | 9.457584 | 703 | 9.981361 | 63 | 9.476223 | 766 | 10.523777 | 10.018639 | 10.542416 | 20 |
| 41 | 9.458006 | 702 | 9.981323 | 63 | 9.476683 | 765 | 10.523317 | 10.018677 | 10.541994 | 19 |
| 42 | 9.458427 | 701 | 9.981285 | 63 | 9.477142 | 765 | 10.522858 | 10.018715 | 10.541573 | 18 |
| 43 | 9.458848 | 701 | 9.981247 | 63 | 9.477601 | 764 | 10.522399 | 10.018753 | 10.541152 | 17 |
| 44 | 9.459268 | 700 | 9.981209 | 63 | 9.478059 | 763 | 10.521941 | 10.018791 | 10.540732 | 16 |
| 45 | 9.459688 | 699 | 9.981171 | 63 | 9.478517 | 763 | 10.521483 | 10.018829 | 10.540312 | 15 |
| 46 | 9.460108 | 698 | 9.981133 | 63 | 9.478975 | 762 | 10.521025 | 10.018867 | 10.539892 | 14 |
| 47 | 9.460527 | 698 | 9.981095 | 63 | 9.479432 | 761 | 10.520568 | 10.018905 | 10.539473 | 13 |
| 48 | 9.460946 | 697 | 9.981057 | 63 | 9.479889 | 761 | 10.520111 | 10.018943 | 10.539054 | 12 |
| 49 | 9.461364 | 696 | 9.981019 | 63 | 9.480345 | 760 | 10.519655 | 10.018981 | 10.538636 | 11 |
| 50 | 9.461782 | 695 | 9.980981 | 65 | 9.480801 | 759 | 10.519199 | 10.019019 | 10.538218 | 10 |
| 51 | 9.462199 | 695 | 9.980942 | 63 | 9.481257 | 759 | 10.518743 | 10.019058 | 10.537801 | 9 |
| 52 | 9.462616 | 694 | 9.980904 | 63 | 9.481712 | 758 | 10.518288 | 10.019096 | 10.537384 | 8 |
| 53 | 9.463032 | 693 | 9.980866 | 65 | 9.482167 | 757 | 10.517833 | 10.019134 | 10.536968 | 7 |
| 54 | 9.463448 | 693 | 9.980827 | 63 | 9.482621 | 757 | 10.517379 | 10.019173 | 10.536552 | 6 |
| 55 | 9.463864 | 692 | 9.980789 | 65 | 9.483075 | 756 | 10.516925 | 10.019211 | 10.536136 | 5 |
| 56 | 9.464279 | 691 | 9.980750 | 63 | 9.483529 | 755 | 10.516471 | 10.019250 | 10.535721 | 4 |
| 57 | 9.464694 | 690 | 9.980712 | 65 | 9.483982 | 755 | 10.516018 | 10.019288 | 10.535306 | 3 |
| 58 | 9.465108 | 690 | 9.980673 | 63 | 9.484435 | 754 | 10.515565 | 10.019327 | 10.534892 | 2 |
| 59 | 9.465522 | 689 | 9.980635 | 65 | 9.484887 | 753 | 10.515113 | 10.019365 | 10.534478 | 1 |
| 60 | 9.465935 | | 9.980596 | | 9.485339 | | 10.514661 | 10.019404 | 10.534065 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

### 73 Degrees.

17 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.465935 | 688 | 9.980596 | 63 | 9.485339 | 753 | 10.514661 | 10.019404 | 10.534065 | 60 |
| 1 | 9.466348 | 688 | 9.980558 | 65 | 9.485701 | 752 | 10.514209 | 10.019442 | 10.533652 | 59 |
| 2 | 9.466761 | 687 | 9.980519 | 65 | 9.486242 | 751 | 10.513758 | 10.019481 | 10.533239 | 58 |
| 3 | 9.467173 | 686 | 9.980480 | 63 | 9.486693 | 751 | 10.513307 | 10.019520 | 10.532827 | 57 |
| 4 | 9.467585 | 685 | 9.980442 | 65 | 9.487143 | 750 | 10.512857 | 10.019558 | 10.532415 | 56 |
| 5 | 9.467996 | 685 | 9.980403 | 65 | 9.487593 | 749 | 10.512407 | 10.019597 | 10.532004 | 55 |
| 6 | 9.468407 | 684 | 9.980364 | 65 | 9.488043 | 749 | 10.511957 | 10.019636 | 10.531593 | 54 |
| 7 | 9.468817 | 683 | 9.980325 | 65 | 9.488492 | 748 | 10.511508 | 10.019675 | 10.531183 | 53 |
| 8 | 9.469227 | 683 | 9.980286 | 65 | 9.488941 | 747 | 10.511059 | 10.019714 | 10.530773 | 52 |
| 9 | 9.469637 | 682 | 9.980247 | 65 | 9.489390 | 747 | 10.510610 | 10.019753 | 10.530363 | 51 |
| 10 | 9.470046 | 681 | 9.980208 | 65 | 9.489838 | 746 | 10.510162 | 10.019792 | 10.529954 | 50 |
| 11 | 9.470455 | 680 | 9.980169 | 65 | 9.490286 | 746 | 10.509714 | 10.019831 | 10.529545 | 49 |
| 12 | 9.470863 | 680 | 9.980130 | 65 | 9.490733 | 745 | 10.509267 | 10.019870 | 10.529137 | 48 |
| 13 | 9.471271 | 679 | 9.980091 | 65 | 9.491180 | 744 | 10.508820 | 10.019909 | 10.528729 | 47 |
| 14 | 9.471679 | 678 | 9.980052 | 67 | 9.491627 | 744 | 10.508373 | 10.019948 | 10.528321 | 46 |
| 15 | 9.472086 | 678 | 9.980012 | 65 | 9.492073 | 743 | 10.507927 | 10.019988 | 10.527914 | 45 |
| 16 | 9.472492 | 677 | 9.979973 | 65 | 9.492519 | 743 | 10.507481 | 10.020027 | 10.527508 | 44 |
| 17 | 9.472898 | 676 | 9.979934 | 65 | 9.492965 | 742 | 10.507035 | 10.020066 | 10.527102 | 43 |
| 18 | 9.473304 | 676 | 9.979895 | 67 | 9.493410 | 741 | 10.506590 | 10.020105 | 10.526696 | 42 |
| 19 | 9.473710 | 675 | 9.979855 | 65 | 9.493854 | 740 | 10.506146 | 10.020145 | 10.526290 | 41 |
| 20 | 9.474115 | 674 | 9.979816 | 67 | 9.494299 | 740 | 10.505701 | 10.020184 | 10.525885 | 40 |
| 21 | 9.474519 | 674 | 9.979776 | 65 | 9.494743 | 739 | 10.505257 | 10.020224 | 10.525481 | 39 |
| 22 | 9.474923 | 673 | 9.979737 | 67 | 9.495186 | 739 | 10.504814 | 10.020263 | 10.525077 | 38 |
| 23 | 9.475327 | 672 | 9.979697 | 65 | 9.495630 | 738 | 10.504370 | 10.020303 | 10.524673 | 37 |
| 24 | 9.475730 | 672 | 9.979658 | 67 | 9.496073 | 737 | 10.503927 | 10.020342 | 10.524270 | 36 |
| 25 | 9.476133 | 671 | 9.979618 | 65 | 9.496515 | 737 | 10.503485 | 10.020382 | 10.523867 | 35 |
| 26 | 9.476536 | 670 | 9.979579 | 67 | 9.496957 | 736 | 10.503043 | 10.020421 | 10.523464 | 34 |
| 27 | 9.476938 | 669 | 9.979539 | 67 | 9.497399 | 736 | 10.502601 | 10.020461 | 10.523062 | 33 |
| 28 | 9.477340 | 669 | 9.979499 | 67 | 9.497841 | 735 | 10.502159 | 10.020501 | 10.522660 | 32 |
| 29 | 9.477741 | 668 | 9.979459 | 65 | 9.498282 | 734 | 10.501718 | 10.020541 | 10.522259 | 31 |
| 30 | 9.478142 | 667 | 9.979420 | 67 | 9.498722 | 734 | 10.501278 | 10.020580 | 10.521858 | 30 |
| 31 | 9.478542 | 667 | 9.979380 | 67 | 9.499163 | 733 | 10.500837 | 10.020620 | 10.521458 | 29 |
| 32 | 9.478942 | 666 | 9.979340 | 67 | 9.499603 | 733 | 10.500397 | 10.020660 | 10.521058 | 28 |
| 33 | 9.479342 | 665 | 9.979300 | 67 | 9.500042 | 732 | 10.499958 | 10.020700 | 10.520658 | 27 |
| 34 | 9.479741 | 665 | 9.979260 | 67 | 9.500481 | 731 | 10.499519 | 10.020740 | 10.520259 | 26 |
| 35 | 9.480140 | 664 | 9.979220 | 67 | 9.500920 | 731 | 10.499080 | 10.020780 | 10.519860 | 25 |
| 36 | 9.480539 | 663 | 9.979180 | 67 | 9.501359 | 730 | 10.498641 | 10.020820 | 10.519461 | 24 |
| 37 | 9.480937 | 663 | 9.979140 | 67 | 9.501797 | 730 | 10.498203 | 10.020860 | 10.519063 | 23 |
| 38 | 9.481334 | 662 | 9.979100 | 68 | 9.502235 | 729 | 10.497765 | 10.020900 | 10.518666 | 22 |
| 39 | 9.481731 | 661 | 9.979059 | 67 | 9.502672 | 728 | 10.497328 | 10.020941 | 10.518269 | 21 |
| 40 | 9.482128 | 661 | 9.979019 | 67 | 9.503109 | 728 | 10.496891 | 10.020981 | 10.517872 | 20 |
| 41 | 9.482525 | 660 | 9.978979 | 67 | 9.503546 | 727 | 10.496454 | 10.021021 | 10.517475 | 19 |
| 42 | 9.482921 | 659 | 9.978939 | 68 | 9.503982 | 727 | 10.496018 | 10.021061 | 10.517079 | 18 |
| 43 | 9.483316 | 659 | 9.978898 | 67 | 9.504418 | 726 | 10.495582 | 10.021102 | 10.516684 | 17 |
| 44 | 9.483712 | 658 | 9.978858 | 68 | 9.504854 | 725 | 10.495146 | 10.021142 | 10.516288 | 16 |
| 45 | 9.484107 | 657 | 9.978817 | 67 | 9.505289 | 725 | 10.494711 | 10.021183 | 10.515893 | 15 |
| 46 | 9.484501 | 657 | 9.978777 | 67 | 9.505724 | 724 | 10.494276 | 10.021223 | 10.515499 | 14 |
| 47 | 9.484896 | 656 | 9.978737 | 68 | 9.506159 | 724 | 10.493841 | 10.021263 | 10.515105 | 13 |
| 48 | 9.485289 | 655 | 9.978696 | 68 | 9.506593 | 723 | 10.493407 | 10.021304 | 10.514711 | 12 |
| 49 | 9.485683 | 655 | 9.978655 | 67 | 9.507027 | 722 | 10.492973 | 10.021345 | 10.514318 | 11 |
| 50 | 9.486075 | 654 | 9.978615 | 68 | 9.507460 | 722 | 10.492540 | 10.021385 | 10.513925 | 10 |
| 51 | 9.486467 | 653 | 9.978574 | 68 | 9.507893 | 721 | 10.492107 | 10.021426 | 10.513533 | 9 |
| 52 | 9.486860 | 653 | 9.978533 | 67 | 9.508326 | 721 | 10.491674 | 10.021467 | 10.513140 | 8 |
| 53 | 9.487251 | 652 | 9.978493 | 68 | 9.508759 | 720 | 10.491241 | 10.021507 | 10.512749 | 7 |
| 54 | 9.487643 | 651 | 9.978452 | 68 | 9.509191 | 719 | 10.490809 | 10.021548 | 10.512357 | 6 |
| 55 | 9.488034 | 651 | 9.978411 | 68 | 9.509622 | 719 | 10.490378 | 10.021589 | 10.511966 | 5 |
| 56 | 9.488424 | 650 | 9.978370 | 68 | 9.510054 | 718 | 10.489946 | 10.021630 | 10.511576 | 4 |
| 57 | 9.488814 | 650 | 9.978329 | 68 | 9.510485 | 718 | 10.489515 | 10.021671 | 10.511186 | 3 |
| 58 | 9.489204 | 649 | 9.978288 | 68 | 9.510916 | 717 | 10.489084 | 10.021712 | 10.510796 | 2 |
| 59 | 9.489593 | 648 | 9.978247 | 68 | 9.511346 | 717 | 10.488654 | 10.021753 | 10.510407 | 1 |
| 60 | 9.489982 | | 9.978206 | | 9.511776 | | 10.488224 | 10.021794 | 10.510018 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

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LOGARITHMIC SINES, TANGENTS, AND SECANTS.

18 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.489982 | 648 | 9.978206 | 68 | 9.511776 | 716 | 10.488224 | 10.021794 | 10.510018 | 60 |
| 1 | 9.490371 | 648 | 9.978165 | 68 | 9.512206 | 716 | 10.487794 | 10.021835 | 10.509629 | 59 |
| 2 | 9.490759 | 647 | 9.978124 | 68 | 9.512635 | 715 | 10.487365 | 10.021876 | 10.509241 | 58 |
| 3 | 9.491147 | 646 | 9.978083 | 69 | 9.513064 | 714 | 10.486936 | 10.021917 | 10.508853 | 57 |
| 4 | 9.491535 | 646 | 9.978042 | 69 | 9.513493 | 714 | 10.486507 | 10.021958 | 10.508465 | 56 |
| 5 | 9.491922 | 645 | 9.978001 | 69 | 9.513921 | 713 | 10.486079 | 10.021999 | 10.508078 | 55 |
| 6 | 9.492308 | 644 | 9.977959 | 69 | 9.514349 | 713 | 10.485651 | 10.022041 | 10.507692 | 54 |
| 7 | 9.492695 | 644 | 9.977918 | 69 | 9.514777 | 712 | 10.485223 | 10.022082 | 10.507305 | 53 |
| 8 | 9.493081 | 643 | 9.977877 | 69 | 9.515204 | 712 | 10.484796 | 10.022123 | 10.506919 | 52 |
| 9 | 9.493466 | 642 | 9.977835 | 69 | 9.515631 | 711 | 10.484369 | 10.022165 | 10.506534 | 51 |
| 10 | 9.493851 | 642 | 9.977794 | 69 | 9.516057 | 710 | 10.483943 | 10.022206 | 10.506149 | 50 |
| 11 | 9.494236 | 641 | 9.977752 | 69 | 9.516484 | 710 | 10.483516 | 10.022248 | 10.505764 | 49 |
| 12 | 9.494621 | 641 | 9.977711 | 69 | 9.516910 | 709 | 10.483090 | 10.022289 | 10.505379 | 48 |
| 13 | 9.495005 | 640 | 9.977669 | 69 | 9.517335 | 709 | 10.482665 | 10.022331 | 10.504995 | 47 |
| 14 | 9.495388 | 639 | 9.977628 | 69 | 9.517761 | 708 | 10.482239 | 10.022372 | 10.504612 | 46 |
| 15 | 9.495772 | 639 | 9.977586 | 69 | 9.518185 | 708 | 10.481815 | 10.022414 | 10.504228 | 45 |
| 16 | 9.496154 | 638 | 9.977544 | 70 | 9.518610 | 707 | 10.481390 | 10.022456 | 10.503846 | 44 |
| 17 | 9.496537 | 637 | 9.977503 | 70 | 9.519034 | 706 | 10.480966 | 10.022497 | 10.503463 | 43 |
| 18 | 9.496919 | 637 | 9.977461 | 70 | 9.519458 | 706 | 10.480542 | 10.022539 | 10.503081 | 42 |
| 19 | 9.497301 | 636 | 9.977419 | 70 | 9.519882 | 705 | 10.480118 | 10.022581 | 10.502699 | 41 |
| 20 | 9.497682 | 636 | 9.977377 | 70 | 9.520305 | 705 | 10.479695 | 10.022623 | 10.502318 | 40 |
| 21 | 9.498064 | 635 | 9.977335 | 70 | 9.520728 | 704 | 10.479272 | 10.022665 | 10.501936 | 39 |
| 22 | 9.498444 | 634 | 9.977293 | 70 | 9.521151 | 704 | 10.478849 | 10.022707 | 10.501556 | 38 |
| 23 | 9.498825 | 634 | 9.977251 | 70 | 9.521573 | 703 | 10.478427 | 10.022749 | 10.501175 | 37 |
| 24 | 9.499204 | 633 | 9.977209 | 70 | 9.521995 | 703 | 10.478005 | 10.022791 | 10.500796 | 36 |
| 25 | 9.499584 | 632 | 9.977167 | 70 | 9.522417 | 702 | 10.477583 | 10.022833 | 10.500416 | 35 |
| 26 | 9.499963 | 632 | 9.977125 | 70 | 9.522838 | 702 | 10.477162 | 10.022875 | 10.500037 | 34 |
| 27 | 9.500342 | 631 | 9.977083 | 70 | 9.523259 | 701 | 10.476741 | 10.022917 | 10.499658 | 33 |
| 28 | 9.500721 | 631 | 9.977041 | 70 | 9.523680 | 701 | 10.476320 | 10.022959 | 10.499279 | 32 |
| 29 | 9.501099 | 630 | 9.976999 | 70 | 9.524100 | 700 | 10.475900 | 10.023001 | 10.498901 | 31 |
| 30 | 9.501476 | 629 | 9.976957 | 70 | 9.524520 | 699 | 10.475480 | 10.023043 | 10.498524 | 30 |
| 31 | 9.501854 | 629 | 9.976914 | 70 | 9.524939 | 699 | 10.475061 | 10.023086 | 10.498146 | 29 |
| 32 | 9.502231 | 628 | 9.976872 | 70 | 9.525359 | 698 | 10.474641 | 10.023128 | 10.497769 | 28 |
| 33 | 9.502607 | 628 | 9.976830 | 71 | 9.525778 | 698 | 10.474222 | 10.023170 | 10.497393 | 27 |
| 34 | 9.502984 | 627 | 9.976787 | 71 | 9.526197 | 697 | 10.473803 | 10.023213 | 10.497016 | 26 |
| 35 | 9.503360 | 626 | 9.976745 | 71 | 9.526615 | 697 | 10.473385 | 10.023255 | 10.496640 | 25 |
| 36 | 9.503735 | 626 | 9.976702 | 71 | 9.527033 | 696 | 10.472967 | 10.023298 | 10.496265 | 24 |
| 37 | 9.504110 | 625 | 9.976660 | 71 | 9.527451 | 696 | 10.472549 | 10.023340 | 10.495890 | 23 |
| 38 | 9.504485 | 625 | 9.976617 | 71 | 9.527868 | 695 | 10.472132 | 10.023383 | 10.495515 | 22 |
| 39 | 9.504860 | 624 | 9.976574 | 71 | 9.528285 | 695 | 10.471715 | 10.023426 | 10.495140 | 21 |
| 40 | 9.505234 | 623 | 9.976532 | 71 | 9.528702 | 694 | 10.471298 | 10.023468 | 10.494766 | 20 |
| 41 | 9.505608 | 623 | 9.976489 | 71 | 9.529119 | 694 | 10.470881 | 10.023511 | 10.494392 | 19 |
| 42 | 9.505981 | 622 | 9.976446 | 71 | 9.529535 | 693 | 10.470465 | 10.023554 | 10.494019 | 18 |
| 43 | 9.506354 | 622 | 9.976404 | 71 | 9.529950 | 693 | 10.470050 | 10.023596 | 10.493646 | 17 |
| 44 | 9.506727 | 621 | 9.976361 | 71 | 9.530366 | 692 | 10.469634 | 10.023639 | 10.493273 | 16 |
| 45 | 9.507099 | 620 | 9.976318 | 71 | 9.530781 | 691 | 10.469219 | 10.023682 | 10.492901 | 15 |
| 46 | 9.507471 | 620 | 9.976275 | 71 | 9.531196 | 691 | 10.468804 | 10.023725 | 10.492529 | 14 |
| 47 | 9.507843 | 619 | 9.976232 | 72 | 9.531611 | 690 | 10.468389 | 10.023768 | 10.492157 | 13 |
| 48 | 9.508214 | 619 | 9.976189 | 72 | 9.532025 | 690 | 10.467975 | 10.023811 | 10.491786 | 12 |
| 49 | 9.508585 | 618 | 9.976146 | 72 | 9.532439 | 689 | 10.467561 | 10.023854 | 10.491415 | 11 |
| 50 | 9.508956 | 618 | 9.976103 | 72 | 9.532853 | 689 | 10.467147 | 10.023897 | 10.491044 | 10 |
| 51 | 9.509326 | 617 | 9.976060 | 72 | 9.533266 | 688 | 10.466734 | 10.023940 | 10.490674 | 9 |
| 52 | 9.509696 | 616 | 9.976017 | 72 | 9.533679 | 688 | 10.466321 | 10.023983 | 10.490304 | 8 |
| 53 | 9.510065 | 616 | 9.975974 | 72 | 9.534092 | 687 | 10.465908 | 10.024026 | 10.489935 | 7 |
| 54 | 9.510434 | 615 | 9.975930 | 72 | 9.534504 | 687 | 10.465496 | 10.024070 | 10.489566 | 6 |
| 55 | 9.510803 | 615 | 9.975887 | 72 | 9.534916 | 686 | 10.465084 | 10.024113 | 10.489197 | 5 |
| 56 | 9.511172 | 614 | 9.975844 | 72 | 9.535328 | 686 | 10.464672 | 10.024156 | 10.488828 | 4 |
| 57 | 9.511540 | 613 | 9.975800 | 72 | 9.535739 | 685 | 10.464261 | 10.024200 | 10.488460 | 3 |
| 58 | 9.511907 | 613 | 9.975757 | 72 | 9.536150 | 685 | 10.463850 | 10.024243 | 10.488093 | 2 |
| 59 | 9.512275 | 612 | 9.975714 | 72 | 9.536561 | 684 | 10.463439 | 10.024286 | 10.487725 | 1 |
| 60 | 9.512642 | | 9.975670 | | 9.536972 | | 10.463028 | 10.024330 | 10.487358 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

71 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 19 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.512642 | 612 | 9.975670 | 72 | 9.536972 | 681 | 10.463028 | 10.024330 | 10.487358 | 60 |
| 1 | 9.513009 | 611 | 9.975627 | 73 | 9.537382 | 683 | 10.462618 | 10.024373 | 10.486991 | 59 |
| 2 | 9.513375 | 611 | 9.975583 | 73 | 9.537792 | 683 | 10.462208 | 10.024417 | 10.486625 | 58 |
| 3 | 9.513741 | 610 | 9.975539 | 73 | 9.538202 | 682 | 10.461798 | 10.024461 | 10.486259 | 57 |
| 4 | 9.514107 | 609 | 9.975496 | 73 | 9.538611 | 682 | 10.461389 | 10.024504 | 10.485893 | 56 |
| 5 | 9.514472 | 609 | 9.975452 | 73 | 9.539020 | 681 | 10.460980 | 10.024548 | 10.485528 | 55 |
| 6 | 9.514837 | 608 | 9.975408 | 73 | 9.539429 | 681 | 10.460571 | 10.024592 | 10.485163 | 54 |
| 7 | 9.515202 | 608 | 9.975365 | 73 | 9.539837 | 680 | 10.460163 | 10.024635 | 10.484798 | 53 |
| 8 | 9 515566 | 607 | 9.975321 | 73 | 9.540245 | 680 | 10.459755 | 10.024679 | 10.484434 | 52 |
| 9 | 9.515930 | 607 | 9.975277 | 73 | 9.540653 | 679 | 10.459347 | 10.024723 | 10.484070 | 51 |
| 10 | 9.516294 | 606 | 9.975233 | 73 | 9.541061 | 679 | 10.458939 | 10.024767 | 10.483706 | 50 |
| 11 | 9.516657 | 605 | 9.975189 | 73 | 9.541468 | 678 | 10.458532 | 10.024811 | 10.483343 | 49 |
| 12 | 9.517020 | 605 | 9.975145 | 73 | 9.541875 | 678 | 10.458125 | 10.024855 | 10.482980 | 48 |
| 13 | 9.517382 | 604 | 9.975101 | 73 | 9.542281 | 677 | 10.457719 | 10.024899 | 10.482618 | 47 |
| 14 | 9.517745 | 604 | 9.975057 | 73 | 9.542688 | 677 | 10.457312 | 10.024943 | 10.482255 | 46 |
| 15 | 9.518107 | 603 | 9.975013 | 73 | 9.543094 | 676 | 10.456906 | 10.024987 | 10.481893 | 45 |
| 16 | 9.518468 | 603 | 9.974969 | 74 | 9.543499 | 676 | 10.456501 | 10.025031 | 10.481532 | 44 |
| 17 | 9.518829 | 602 | 9.974925 | 74 | 9.543905 | 675 | 10.456095 | 10.025075 | 10.481171 | 43 |
| 18 | 9.519190 | 601 | 9.974880 | 74 | 9.544310 | 675 | 10.455690 | 10.025120 | 10.480810 | 42 |
| 19 | 9.519551 | 601 | 9.974836 | 74 | 9.544715 | 674 | 10.455285 | 10.025164 | 10.480449 | 41 |
| 20 | 9.519911 | 600 | 9.974792 | 74 | 9.545119 | 674 | 10.454881 | 10.025208 | 10.480089 | 40 |
| 21 | 9.520271 | 600 | 9.974748 | 74 | 9.545524 | 673 | 10.454476 | 10.025252 | 10.479729 | 39 |
| 22 | 9.520631 | 599 | 9.974703 | 74 | 9.545928 | 673 | 10.454072 | 10.025297 | 10.479369 | 38 |
| 23 | 9.520990 | 599 | 9.974659 | 74 | 9.546331 | 672 | 10.453669 | 10.025341 | 10.479010 | 37 |
| 24 | 9.521349 | 598 | 9.974614 | 74 | 9.546735 | 672 | 10.453265 | 10.025386 | 10.478651 | 36 |
| 25 | 9.521707 | 598 | 9.974570 | 74 | 9.547138 | 671 | 10.452862 | 10.025430 | 10.478293 | 35 |
| 26 | 9.522066 | 597 | 9.974525 | 74 | 9.547540 | 671 | 10.452460 | 10.025475 | 10.477934 | 34 |
| 27 | 9.522424 | 596 | 9.974481 | 74 | 9.547943 | 670 | 10.452057 | 10.025519 | 10.477576 | 33 |
| 28 | 9.522781 | 596 | 9.974436 | 74 | 9.548345 | 670 | 10.451655 | 10.025564 | 10.477219 | 32 |
| 29 | 9.523138 | 595 | 9.974391 | 74 | 9.548747 | 669 | 10.451253 | 10.025609 | 10.476862 | 31 |
| 30 | 9.523495 | 595 | 9.974347 | 74 | 9.549149 | 669 | 10.450851 | 10.025653 | 10.476505 | 30 |
| 31 | 9.523852 | 594 | 9.974302 | 75 | 9.549550 | 668 | 10.450450 | 10.025698 | 10.476148 | 29 |
| 32 | 9.524208 | 594 | 9.974257 | 75 | 9.549951 | 668 | 10.450049 | 10.025743 | 10.475792 | 28 |
| 33 | 9.524564 | 593 | 9.974212 | 75 | 9.550352 | 667 | 10.449648 | 10.025788 | 10.475436 | 27 |
| 34 | 9.524920 | 593 | 9.974167 | 75 | 9.550752 | 667 | 10.449248 | 10.025833 | 10.475080 | 26 |
| 35 | 9.525275 | 592 | 9.974122 | 75 | 9.551152 | 666 | 10.448848 | 10.025878 | 10.474725 | 25 |
| 36 | 9.525630 | 591 | 9.974077 | 75 | 9.551552 | 666 | 10.448448 | 10.025923 | 10.474370 | 24 |
| 37 | 9.525984 | 591 | 9.974032 | 75 | 9.551952 | 665 | 10.448048 | 10.025968 | 10.474016 | 23 |
| 38 | 9.526339 | 590 | 9.973987 | 75 | 9.552351 | 665 | 10.447649 | 10.026013 | 10.473661 | 22 |
| 39 | 9.526693 | 590 | 9.973942 | 75 | 9.552750 | 665 | 10.447250 | 10.026058 | 10.473307 | 21 |
| 40 | 9.527046 | 589 | 9.973897 | 75 | 9.553149 | 664 | 10.446851 | 10.026103 | 10.472954 | 20 |
| 41 | 9.527400 | 589 | 9.973852 | 75 | 9.553548 | 664 | 10.446452 | 10.026148 | 10.472600 | 19 |
| 42 | 9.527753 | 588 | 9.973807 | 75 | 9.553946 | 663 | 10.446054 | 10.026193 | 10.472247 | 18 |
| 43 | 9.528105 | 588 | 9.973761 | 75 | 9.554344 | 663 | 10.445656 | 10.026239 | 10.471895 | 17 |
| 44 | 9.528458 | 587 | 9.973716 | 76 | 9.554741 | 662 | 10.445259 | 10.026284 | 10.471542 | 16 |
| 45 | 9.528810 | 587 | 9.973671 | 76 | 9.555139 | 662 | 10.444861 | 10.026329 | 10.471190 | 15 |
| 46 | 9.529161 | 586 | 9.973625 | 76 | 9.555536 | 661 | 10.444464 | 10.026375 | 10.470839 | 14 |
| 47 | 9.529513 | 586 | 9.973580 | 76 | 9.555933 | 661 | 10.444067 | 10.026420 | 10.470487 | 13 |
| 48 | 9.529864 | 585 | 9.973535 | 76 | 9.556329 | 660 | 10.443671 | 10.026465 | 10.470136 | 12 |
| 49 | 9.530215 | 585 | 9.973489 | 76 | 9.556725 | 660 | 10.443275 | 10.026511 | 10.469785 | 11 |
| 50 | 9.530565 | 584 | 9.973444 | 76 | 9.557121 | 659 | 10.442879 | 10.026556 | 10.469435 | 10 |
| 51 | 9.530915 | 584 | 9.973398 | 76 | 9.557517 | 659 | 10.442483 | 10.026602 | 10.469085 | 9 |
| 52 | 9.531265 | 583 | 9.973352 | 76 | 9.557913 | 659 | 10.442087 | 10.026648 | 10.468735 | 8 |
| 53 | 9.531614 | 582 | 9.973307 | 76 | 9.558308 | 658 | 10.441692 | 10.026693 | 10.468386 | 7 |
| 54 | 9.531963 | 582 | 9.973261 | 76 | 9.558702 | 658 | 10.441298 | 10.026739 | 10.468037 | 6 |
| 55 | 9.532312 | 581 | 9.973215 | 76 | 9.559097 | 657 | 10.440903 | 10.026785 | 10.467688 | 5 |
| 56 | 9.532661 | 581 | 9.973169 | 76 | 9.559491 | 657 | 10.440509 | 10.026831 | 10.467339 | 4 |
| 57 | 9.533009 | 580 | 9.973121 | 76 | 9.559885 | 656 | 10.440115 | 10.026876 | 10.466991 | 3 |
| 58 | 9.533357 | 580 | 9.973078 | 76 | 9.560279 | 656 | 10.439721 | 10.026922 | 10.466643 | 2 |
| 59 | 9.533704 | 579 | 9.973032 | 76 | 9.560673 | 655 | 10.439327 | 10.026968 | 10.466296 | 1 |
| 60 | 9.534052 | | 9.972986 | | 9.561066 | | 10.438934 | 10.027014 | 10.465948 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 20 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.534052 | 578 | 9.972986 | 77 | 9.561066 | 655 | 10.438934 | 10.027014 | 10.465948 | 60 |
| 1 | 9.534399 | 577 | 9.972940 | 77 | 9.561459 | 654 | 10.438541 | 10.027060 | 10.465601 | 59 |
| 2 | 9.534745 | 577 | 9.972894 | 77 | 9.561851 | 654 | 10.438149 | 10.027106 | 10.465255 | 58 |
| 3 | 9.535092 | 577 | 9.972848 | 77 | 9.562244 | 653 | 10.437756 | 10.027152 | 10.464908 | 57 |
| 4 | 9.535438 | 576 | 9.972802 | 78 | 9.562636 | 653 | 10.437364 | 10.027198 | 10.464562 | 56 |
| 5 | 9.535783 | 576 | 9.972755 | 77 | 9.563028 | 653 | 10.436972 | 10.027245 | 10.464217 | 55 |
| 6 | 9.536129 | 575 | 9.972709 | 77 | 9.563419 | 652 | 10.436581 | 10.027291 | 10.463871 | 54 |
| 7 | 9.536474 | 574 | 9.972663 | 77 | 9.563811 | 652 | 10.436189 | 10.027337 | 10.463526 | 53 |
| 8 | 9.536818 | 574 | 9.972617 | 78 | 9.564202 | 651 | 10.435798 | 10.027383 | 10.463182 | 52 |
| 9 | 9.537163 | 573 | 9.972570 | 77 | 9.564592 | 651 | 10.435408 | 10.027430 | 10.462837 | 51 |
| 10 | 9.537507 | 573 | 9.972524 | 77 | 9.564983 | 650 | 10.435017 | 10.027476 | 10.462493 | 50 |
| 11 | 9.537851 | 572 | 9.972478 | 78 | 9.565373 | 650 | 10.434627 | 10.027522 | 10.462149 | 49 |
| 12 | 9.538194 | 572 | 9.972431 | 77 | 9.565763 | 649 | 10.434237 | 10.027569 | 10.461806 | 48 |
| 13 | 9.538538 | 571 | 9.972385 | 78 | 9.566153 | 649 | 10.433847 | 10.027615 | 10.461462 | 47 |
| 14 | 9.538880 | 571 | 9.972338 | 78 | 9.566542 | 649 | 10.433458 | 10.027662 | 10.461120 | 46 |
| 15 | 9.539223 | 570 | 9.972291 | 77 | 9.566932 | 648 | 10.433068 | 10.027709 | 10.460777 | 45 |
| 16 | 9.539565 | 570 | 9.972245 | 78 | 9.567320 | 648 | 10.432680 | 10.027755 | 10.460435 | 44 |
| 17 | 9.539907 | 569 | 9.972198 | 78 | 9.567709 | 647 | 10.432291 | 10.027802 | 10.460093 | 43 |
| 18 | 9.540249 | 569 | 9.972151 | 77 | 9.568098 | 647 | 10.431902 | 10.027849 | 10.459751 | 42 |
| 19 | 9.540590 | 568 | 9.972105 | 78 | 9.568486 | 646 | 10.431514 | 10.027895 | 10.459410 | 41 |
| 20 | 9.540931 | 568 | 9.972058 | 78 | 9.568873 | 646 | 10.431127 | 10.027942 | 10.459069 | 40 |
| 21 | 9.541272 | 567 | 9.972011 | 78 | 9.569261 | 645 | 10.430739 | 10.027989 | 10.458728 | 39 |
| 22 | 9.541613 | 567 | 9.971964 | 78 | 9.569648 | 645 | 10.430352 | 10.028036 | 10.458387 | 38 |
| 23 | 9.541953 | 566 | 9.971917 | 78 | 9.570035 | 645 | 10.429965 | 10.028083 | 10.458047 | 37 |
| 24 | 9.542293 | 566 | 9.971870 | 78 | 9.570422 | 644 | 10.429578 | 10.028130 | 10.457707 | 36 |
| 25 | 9.542632 | 565 | 9.971823 | 78 | 9.570809 | 644 | 10.429191 | 10.028177 | 10.457368 | 35 |
| 26 | 9.542971 | 565 | 9.971776 | 78 | 9.571195 | 643 | 10.428805 | 10.028224 | 10.457029 | 34 |
| 27 | 9.543310 | 564 | 9.971729 | 78 | 9.571581 | 643 | 10.428419 | 10.028271 | 10.456690 | 33 |
| 28 | 9.543649 | 564 | 9.971682 | 78 | 9.571967 | 642 | 10.428033 | 10.028318 | 10.456351 | 32 |
| 29 | 9.543987 | 563 | 9.971635 | 78 | 9.572352 | 642 | 10.427648 | 10.028365 | 10.456013 | 31 |
| 30 | 9.544325 | 563 | 9.971588 | 80 | 9.572738 | 642 | 10.427262 | 10.028412 | 10.455675 | 30 |
| 31 | 9.544663 | 562 | 9.971540 | 78 | 9.573123 | 641 | 10.426877 | 10.028460 | 10.455337 | 29 |
| 32 | 9.545000 | 562 | 9.971493 | 78 | 9.573507 | 641 | 10.426493 | 10.028507 | 10.455000 | 28 |
| 33 | 9.545338 | 561 | 9.971446 | 80 | 9.573892 | 640 | 10.426108 | 10.028554 | 10.454662 | 27 |
| 34 | 9.545674 | 561 | 9.971398 | 78 | 9.574276 | 640 | 10.425724 | 10.028602 | 10.454326 | 26 |
| 35 | 9.546011 | 560 | 9.971351 | 80 | 9.574660 | 639 | 10.425340 | 10.028649 | 10.453989 | 25 |
| 36 | 9.546347 | 560 | 9.971303 | 78 | 9.575044 | 639 | 10.424956 | 10.028697 | 10.453653 | 24 |
| 37 | 9.546683 | 559 | 9.971256 | 80 | 9.575427 | 639 | 10.424573 | 10.028744 | 10.453317 | 23 |
| 38 | 9.547019 | 559 | 9.971208 | 78 | 9.575810 | 638 | 10.424190 | 10.028792 | 10.452981 | 22 |
| 39 | 9.547354 | 558 | 9.971161 | 80 | 9.576193 | 638 | 10.423807 | 10.028839 | 10.452646 | 21 |
| 40 | 9.547689 | 558 | 9.971113 | 78 | 9.576576 | 637 | 10.423424 | 10.028887 | 10.452311 | 20 |
| 41 | 9.548024 | 557 | 9.971066 | 80 | 9.576958 | 637 | 10.423042 | 10.028934 | 10.451976 | 19 |
| 42 | 9.548359 | 557 | 9.971018 | 80 | 9.577341 | 636 | 10.422659 | 10.028982 | 10.451641 | 18 |
| 43 | 9.548693 | 556 | 9.970970 | 80 | 9.577723 | 636 | 10.422277 | 10.029030 | 10.451307 | 17 |
| 44 | 9.549027 | 556 | 9.970922 | 80 | 9.578104 | 636 | 10.421896 | 10.029078 | 10.450973 | 16 |
| 45 | 9.549360 | 555 | 9.970874 | 78 | 9.578486 | 635 | 10.421514 | 10.029126 | 10.450640 | 15 |
| 46 | 9.549693 | 555 | 9.970827 | 80 | 9.578867 | 635 | 10.421133 | 10.029173 | 10.450307 | 14 |
| 47 | 9.550026 | 554 | 9.970779 | 80 | 9.579248 | 634 | 10.420752 | 10.029221 | 10.449974 | 13 |
| 48 | 9.550359 | 554 | 9.970731 | 80 | 9.579629 | 634 | 10.420371 | 10.029269 | 10.449641 | 12 |
| 49 | 9.550692 | 553 | 9.970683 | 80 | 9.580009 | 634 | 10.419991 | 10.029317 | 10.449308 | 11 |
| 50 | 9.551024 | 553 | 9.970635 | 82 | 9.580389 | 633 | 10.419611 | 10.029365 | 10.448976 | 10 |
| 51 | 9.551356 | 552 | 9.970586 | 80 | 9.580769 | 633 | 10.419231 | 10.029414 | 10.448644 | 9 |
| 52 | 9.551687 | 552 | 9.970538 | 80 | 9.581149 | 632 | 10.418851 | 10.029462 | 10.448313 | 8 |
| 53 | 9.552018 | 552 | 9.970490 | 80 | 9.581528 | 632 | 10.418472 | 10.029510 | 10.447982 | 7 |
| 54 | 9.552349 | 551 | 9.970442 | 80 | 9.581907 | 632 | 10.418093 | 10.029558 | 10.447651 | 6 |
| 55 | 9.552680 | 551 | 9.970394 | 82 | 9.582286 | 631 | 10.417714 | 10.029606 | 10.447320 | 5 |
| 56 | 9.553010 | 550 | 9.970345 | 80 | 9.582665 | 631 | 10.417335 | 10.029655 | 10.446990 | 4 |
| 57 | 9.553341 | 550 | 9.970297 | 80 | 9.583043 | 630 | 10.416957 | 10.029703 | 10.446659 | 3 |
| 58 | 9.553670 | 549 | 9.970249 | 82 | 9.583422 | 630 | 10.416578 | 10.029751 | 10.446330 | 2 |
| 59 | 9.554000 | 549 | 9.970200 | 80 | 9.583800 | 629 | 10.416200 | 10.029800 | 10.446000 | 1 |
| 60 | 9.554329 | | 9.970152 | | 9.584177 | | 10.415823 | 10.029848 | 10.445671 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

### 69 Degrees.

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## 21 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.554329 | 548 | 9.970152 | 81 | 9.584177 | 629 | 10.415823 | 10.029848 | 10.445671 | 60 |
| 1 | 9.554658 | 548 | 9.970103 | 81 | 9.584555 | 629 | 10.415445 | 10.029897 | 10.445342 | 59 |
| 2 | 9.554987 | 547 | 9.970055 | 81 | 9.584932 | 628 | 10.415068 | 10.029945 | 10.445013 | 58 |
| 3 | 9.555315 | 547 | 9.970006 | 81 | 9.585309 | 628 | 10.414691 | 10.029994 | 10.444685 | 57 |
| 4 | 9.555643 | 546 | 9.969957 | 81 | 9.585686 | 627 | 10.414314 | 10.030043 | 10.444357 | 56 |
| 5 | 9.555971 | 546 | 9.969909 | 81 | 9.586062 | 627 | 10.413938 | 10.030091 | 10.444029 | 55 |
| 6 | 9.556299 | 546 | 9.969860 | 81 | 9.586439 | 627 | 10.413561 | 10.030140 | 10.443701 | 54 |
| 7 | 9.556626 | 545 | 9.969811 | 81 | 9.586815 | 626 | 10.413185 | 10.030189 | 10.443374 | 53 |
| 8 | 9.556953 | 544 | 9.969762 | 81 | 9.587190 | 626 | 10.412810 | 10.030238 | 10.443047 | 52 |
| 9 | 9.557280 | 544 | 9.969714 | 81 | 9.587566 | 625 | 10.412434 | 10.030286 | 10.442720 | 51 |
| 10 | 9.557606 | 543 | 9.969665 | 81 | 9.587941 | 625 | 10.412059 | 10.030335 | 10.442394 | 50 |
| 11 | 9.557932 | 543 | 9.969616 | 82 | 9.588316 | 625 | 10.411684 | 10.030384 | 10.442068 | 49 |
| 12 | 9.558258 | 543 | 9.969567 | 82 | 9.588691 | 624 | 10.411309 | 10.030433 | 10.441742 | 48 |
| 13 | 9.558583 | 542 | 9.969518 | 82 | 9.589066 | 624 | 10.410934 | 10.030482 | 10.441417 | 47 |
| 14 | 9.558909 | 542 | 9.969469 | 82 | 9.589440 | 623 | 10.410560 | 10.030531 | 10.441091 | 46 |
| 15 | 9.559234 | 541 | 9.969420 | 82 | 9.589814 | 623 | 10.410186 | 10.030580 | 10.440766 | 45 |
| 16 | 9.559558 | 541 | 9.969370 | 82 | 9.590188 | 623 | 10.409812 | 10.030630 | 10.440442 | 44 |
| 17 | 9.559883 | 540 | 9.969321 | 82 | 9.590562 | 622 | 10.409438 | 10.030679 | 10.440117 | 43 |
| 18 | 9.560207 | 540 | 9.969272 | 82 | 9.590935 | 622 | 10.409065 | 10.030728 | 10.439793 | 42 |
| 19 | 9.560531 | 539 | 9.969223 | 82 | 9.591308 | 622 | 10.408692 | 10.030777 | 10.439469 | 41 |
| 20 | 9.560855 | 539 | 9.969173 | 82 | 9.591681 | 621 | 10.408319 | 10.030827 | 10.439145 | 40 |
| 21 | 9.561178 | 538 | 9.969124 | 82 | 9.592054 | 621 | 10.407946 | 10.030876 | 10.438822 | 39 |
| 22 | 9.561501 | 538 | 9.969075 | 82 | 9.592426 | 620 | 10.407574 | 10.030925 | 10.438499 | 38 |
| 23 | 9.561824 | 537 | 9.969025 | 82 | 9.592798 | 620 | 10.407202 | 10.030975 | 10.438176 | 37 |
| 24 | 9.562146 | 537 | 9.968976 | 82 | 9.593171 | 620 | 10.406829 | 10.031024 | 10.437854 | 36 |
| 25 | 9.562468 | 536 | 9.968926 | 83 | 9.593542 | 619 | 10.406458 | 10.031074 | 10.437532 | 35 |
| 26 | 9.562790 | 536 | 9.968877 | 83 | 9.593914 | 619 | 10.406086 | 10.031123 | 10.437210 | 34 |
| 27 | 9.563112 | 536 | 9.968827 | 83 | 9.594285 | 618 | 10.405715 | 10.031173 | 10.436888 | 33 |
| 28 | 9.563433 | 535 | 9.968777 | 83 | 9.594656 | 618 | 10.405344 | 10.031223 | 10.436567 | 32 |
| 29 | 9.563755 | 535 | 9.968728 | 83 | 9.595027 | 618 | 10.404973 | 10.031272 | 10.436245 | 31 |
| 30 | 9.564075 | 534 | 9.968678 | 83 | 9.595398 | 617 | 10.404602 | 10.031322 | 10.435925 | 30 |
| 31 | 9.564396 | 534 | 9.968628 | 83 | 9.595768 | 617 | 10.404232 | 10.031372 | 10.435604 | 29 |
| 32 | 9.564716 | 533 | 9.968578 | 83 | 9.596138 | 616 | 10.403862 | 10.031422 | 10.435284 | 28 |
| 33 | 9.565036 | 533 | 9.968528 | 83 | 9.596508 | 616 | 10.403492 | 10.031472 | 10.434964 | 27 |
| 34 | 9.565356 | 532 | 9.968479 | 83 | 9.596878 | 616 | 10.403122 | 10.031521 | 10.434644 | 26 |
| 35 | 9.565676 | 532 | 9.968429 | 83 | 9.597247 | 615 | 10.402753 | 10.031571 | 10.434324 | 25 |
| 36 | 9.565995 | 531 | 9.968379 | 83 | 9.597616 | 615 | 10.402384 | 10.031621 | 10.434005 | 24 |
| 37 | 9.566314 | 531 | 9.968329 | 83 | 9.597985 | 615 | 10.402015 | 10.031671 | 10.433686 | 23 |
| 38 | 9.566632 | 531 | 9.968278 | 83 | 9.598354 | 614 | 10.401646 | 10.031722 | 10.433368 | 22 |
| 39 | 9.566951 | 530 | 9.968228 | 84 | 9.598722 | 614 | 10.401278 | 10.031772 | 10.433049 | 21 |
| 40 | 9.567269 | 530 | 9.968178 | 84 | 9.599091 | 613 | 10.400909 | 10.031822 | 10.432731 | 20 |
| 41 | 9.567587 | 529 | 9.968128 | 84 | 9.599459 | 613 | 10.400541 | 10.031872 | 10.432413 | 19 |
| 42 | 9.567904 | 529 | 9.968078 | 84 | 9.599827 | 613 | 10.400173 | 10.031922 | 10.432096 | 18 |
| 43 | 9.568222 | 528 | 9.968027 | 84 | 9.600194 | 612 | 10.399806 | 10.031973 | 10.431778 | 17 |
| 44 | 9.568539 | 528 | 9.967977 | 84 | 9.600562 | 612 | 10.399438 | 10.032023 | 10.431461 | 16 |
| 45 | 9.568856 | 528 | 9.967927 | 84 | 9.600929 | 611 | 10.399071 | 10.032073 | 10.431144 | 15 |
| 46 | 9.569172 | 527 | 9.967876 | 84 | 9.601296 | 611 | 10.398704 | 10.032124 | 10.430828 | 14 |
| 47 | 9.569488 | 527 | 9.967826 | 84 | 9.601662 | 611 | 10.398338 | 10.032174 | 10.430512 | 13 |
| 48 | 9.569804 | 526 | 9.967775 | 84 | 9.602029 | 610 | 10.397971 | 10.032225 | 10.430196 | 12 |
| 49 | 9.570120 | 526 | 9.967725 | 84 | 9.602395 | 610 | 10.397605 | 10.032275 | 10.429880 | 11 |
| 50 | 9.570435 | 525 | 9.967674 | 84 | 9.602761 | 610 | 10.397239 | 10.032326 | 10.429565 | 10 |
| 51 | 9.570751 | 525 | 9.967624 | 84 | 9.603127 | 609 | 10.396873 | 10.032376 | 10.429249 | 9 |
| 52 | 9.571066 | 524 | 9.967573 | 84 | 9.603493 | 609 | 10.396507 | 10.032427 | 10.428934 | 8 |
| 53 | 9.571380 | 524 | 9.967522 | 85 | 9.603858 | 609 | 10.396142 | 10.032478 | 10.428620 | 7 |
| 54 | 9.571695 | 523 | 9.967471 | 85 | 9.604223 | 608 | 10.395777 | 10.032529 | 10.428305 | 6 |
| 55 | 9.572009 | 523 | 9.967421 | 85 | 9.604588 | 608 | 10.395412 | 10.032579 | 10.427991 | 5 |
| 56 | 9.572323 | 523 | 9.967370 | 85 | 9.604953 | 607 | 10.395047 | 10.032630 | 10.427677 | 4 |
| 57 | 9.572636 | 522 | 9.967319 | 85 | 9.605317 | 607 | 10.394683 | 10.032681 | 10.427364 | 3 |
| 58 | 9.572950 | 522 | 9.967268 | 85 | 9.605682 | 607 | 10.394318 | 10.032732 | 10.427050 | 2 |
| 59 | 9.573263 | 521 | 9.967217 | 85 | 9.606046 | 606 | 10.393954 | 10.032783 | 10.426737 | 1 |
| 60 | 9.573575 | | 9.967166 | | 9.606410 | | 10.393590 | 10.032834 | 10.426425 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

22 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.573575 | 521 | 9.967166 | 85 | 9.606410 | 606 | 10.393590 | 10.032831 | 10.426425 | 60 |
| 1 | 9.573888 | 520 | 9.967115 | 85 | 9.606773 | 606 | 10.393227 | 10.032885 | 10.426112 | 59 |
| 2 | 9.574200 | 520 | 9.967064 | 85 | 9.607137 | 605 | 10.392863 | 10.032936 | 10.425800 | 58 |
| 3 | 9.574512 | 519 | 9.967013 | 85 | 9.607500 | 605 | 10.392500 | 10.032987 | 10.425488 | 57 |
| 4 | 9.574824 | 519 | 9.966961 | 85 | 9.607863 | 604 | 10.392137 | 10.033039 | 10.425176 | 56 |
| 5 | 9.575136 | 519 | 9.966910 | 85 | 9.608225 | 604 | 10.391775 | 10.033090 | 10.424864 | 55 |
| 6 | 9.575447 | 518 | 9.966859 | 85 | 9.608588 | 604 | 10.391412 | 10.033141 | 10.424553 | 54 |
| 7 | 9.575758 | 518 | 9.966808 | 85 | 9.608950 | 603 | 10.391050 | 10.033192 | 10.424242 | 53 |
| 8 | 9.576069 | 517 | 9.966756 | 86 | 9.609312 | 603 | 10.390688 | 10.033244 | 10.423931 | 52 |
| 9 | 9.576379 | 517 | 9.966705 | 86 | 9.609674 | 603 | 10.390326 | 10.033295 | 10.423621 | 51 |
| 10 | 9.576689 | 516 | 9.966653 | 86 | 9.610036 | 602 | 10.389964 | 10.033347 | 10.423311 | 50 |
| 11 | 9.576999 | 516 | 9.966602 | 86 | 9.610397 | 602 | 10.389603 | 10.033398 | 10.423001 | 49 |
| 12 | 9.577309 | 516 | 9.966550 | 86 | 9.610759 | 602 | 10.389241 | 10.033450 | 10.422691 | 48 |
| 13 | 9.577618 | 515 | 9.966499 | 86 | 9.611120 | 601 | 10.388880 | 10.033501 | 10.422382 | 47 |
| 14 | 9.577927 | 515 | 9.966447 | 86 | 9.611480 | 601 | 10.388520 | 10.033553 | 10.422073 | 46 |
| 15 | 9.578236 | 514 | 9.966395 | 86 | 9.611841 | 601 | 10.388159 | 10.033605 | 10.421764 | 45 |
| 16 | 9.578545 | 514 | 9.966344 | 86 | 9.612201 | 600 | 10.387799 | 10.033656 | 10.421455 | 44 |
| 17 | 9.578853 | 513 | 9.966292 | 86 | 9.612561 | 600 | 10.387439 | 10.033708 | 10.421147 | 43 |
| 18 | 9.579162 | 513 | 9.966240 | 86 | 9.612921 | 600 | 10.387079 | 10.033760 | 10.420838 | 42 |
| 19 | 9.579470 | 513 | 9.966188 | 86 | 9.613281 | 599 | 10.386719 | 10.033812 | 10.420530 | 41 |
| 20 | 9.579777 | 512 | 9.966136 | 86 | 9.613641 | 599 | 10.386359 | 10.033864 | 10.420223 | 40 |
| 21 | 9.580085 | 512 | 9.966085 | 87 | 9.614000 | 598 | 10.386000 | 10.033915 | 10.419915 | 39 |
| 22 | 9.580392 | 511 | 9.966033 | 87 | 9.614359 | 598 | 10.385641 | 10.033967 | 10.419606 | 38 |
| 23 | 9.580699 | 511 | 9.965981 | 87 | 9.614718 | 598 | 10.385282 | 10.034019 | 10.419301 | 37 |
| 24 | 9.581005 | 511 | 9.965929 | 87 | 9.615077 | 597 | 10.384923 | 10.034071 | 10.418995 | 36 |
| 25 | 9.581312 | 510 | 9.965876 | 87 | 9.615435 | 597 | 10.384565 | 10.034124 | 10.418688 | 35 |
| 26 | 9.581618 | 510 | 9.965824 | 87 | 9.615793 | 597 | 10.384207 | 10.034176 | 10.418382 | 34 |
| 27 | 9.581924 | 509 | 9.965772 | 87 | 9.616151 | 596 | 10.383849 | 10.034228 | 10.418076 | 33 |
| 28 | 9.582229 | 509 | 9.965720 | 87 | 9.616509 | 596 | 10.383491 | 10.034280 | 10.417771 | 32 |
| 29 | 9.582535 | 509 | 9.965668 | 87 | 9.616867 | 596 | 10.383133 | 10.034332 | 10.417465 | 31 |
| 30 | 9.582840 | 508 | 9.965615 | 87 | 9.617224 | 595 | 10.382776 | 10.034385 | 10.417160 | 30 |
| 31 | 9.583145 | 508 | 9.965563 | 87 | 9.617582 | 595 | 10.382418 | 10.034437 | 10.416855 | 29 |
| 32 | 9.583449 | 507 | 9.965511 | 87 | 9.617939 | 595 | 10.382061 | 10.034489 | 10.416551 | 28 |
| 33 | 9.583754 | 507 | 9.965458 | 87 | 9.618295 | 594 | 10.381705 | 10.034542 | 10.416246 | 27 |
| 34 | 9.584058 | 506 | 9.965406 | 87 | 9.618652 | 594 | 10.381348 | 10.034594 | 10.415942 | 26 |
| 35 | 9.584361 | 506 | 9.965353 | 88 | 9.619008 | 594 | 10.380992 | 10.034647 | 10.415639 | 25 |
| 36 | 9.584665 | 506 | 9.965301 | 88 | 9.619364 | 593 | 10.380636 | 10.034699 | 10.415335 | 24 |
| 37 | 9.584968 | 505 | 9.965248 | 88 | 9.619721 | 593 | 10.380279 | 10.034752 | 10.415032 | 23 |
| 38 | 9.585272 | 505 | 9.965195 | 88 | 9.620076 | 593 | 10.379924 | 10.034805 | 10.414728 | 22 |
| 39 | 9.585574 | 504 | 9.965143 | 88 | 9.620432 | 592 | 10.379568 | 10.034857 | 10.414426 | 21 |
| 40 | 9.585877 | 504 | 9.965090 | 88 | 9.620787 | 592 | 10.379213 | 10.034910 | 10.414123 | 20 |
| 41 | 9.586179 | 503 | 9.965037 | 88 | 9.621142 | 592 | 10.378858 | 10.034963 | 10.413821 | 19 |
| 42 | 9.586482 | 503 | 9.964984 | 88 | 9.621497 | 591 | 10.378503 | 10.035016 | 10.413518 | 18 |
| 43 | 9.586783 | 503 | 9.964931 | 88 | 9.621852 | 591 | 10.378148 | 10.035069 | 10.413217 | 17 |
| 44 | 9.587085 | 502 | 9.964879 | 88 | 9.622207 | 590 | 10.377793 | 10.035121 | 10.412915 | 16 |
| 45 | 9.587386 | 502 | 9.964826 | 88 | 9.622561 | 590 | 10.377439 | 10.035174 | 10.412614 | 15 |
| 46 | 9.587688 | 501 | 9.964773 | 88 | 9.622915 | 590 | 10.377085 | 10.035227 | 10.412312 | 14 |
| 47 | 9.587989 | 501 | 9.964720 | 88 | 9.623269 | 589 | 10.376731 | 10.035280 | 10.412011 | 13 |
| 48 | 9.588289 | 501 | 9.964666 | 89 | 9.623623 | 589 | 10.376377 | 10.035334 | 10.411711 | 12 |
| 49 | 9.588590 | 500 | 9.964613 | 89 | 9.623976 | 589 | 10.376024 | 10.035387 | 10.411410 | 11 |
| 50 | 9.588890 | 500 | 9.964560 | 89 | 9.624330 | 588 | 10.375670 | 10.035440 | 10.411110 | 10 |
| 51 | 9.589190 | 499 | 9.964507 | 89 | 9.624683 | 588 | 10.375317 | 10.035493 | 10.410810 | 9 |
| 52 | 9.589489 | 499 | 9.964454 | 89 | 9.625036 | 588 | 10.374964 | 10.035546 | 10.410511 | 8 |
| 53 | 9.589789 | 499 | 9.964400 | 89 | 9.625388 | 587 | 10.374612 | 10.035600 | 10.410211 | 7 |
| 54 | 9.590088 | 498 | 9.964347 | 89 | 9.625741 | 587 | 10.374259 | 10.035653 | 10.409912 | 6 |
| 55 | 9.590387 | 498 | 9.964294 | 89 | 9.626093 | 587 | 10.373907 | 10.035706 | 10.409613 | 5 |
| 56 | 9.590686 | 497 | 9.964240 | 89 | 9.626445 | 586 | 10.373555 | 10.035760 | 10.409314 | 4 |
| 57 | 9.590984 | 497 | 9.964187 | 89 | 9.626797 | 586 | 10.373203 | 10.035813 | 10.409016 | 3 |
| 58 | 9.591282 | 497 | 9.964133 | 89 | 9.627149 | 586 | 10.372851 | 10.035867 | 10.408718 | 2 |
| 59 | 9.591580 | 496 | 9.964080 | 89 | 9.627501 | 585 | 10.372499 | 10.035920 | 10.408420 | 1 |
| 60 | 9.591878 | | 9.964026 | | 9.627852 | | 10.372148 | 10.035974 | 10.408122 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

67 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 23 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.591878 | 496 | 9.964026 | 89 | 9.627852 | 585 | 10.372148 | 10.035974 | 10.408122 | 60 |
| 1 | 9.592176 | 495 | 9.963972 | 89 | 9.628203 | 585 | 10.371797 | 10.036028 | 10.407824 | 59 |
| 2 | 9.592473 | 495 | 9.963919 | 89 | 9.628554 | 585 | 10.371446 | 10.036081 | 10.407527 | 58 |
| 3 | 9.592770 | 495 | 9.963865 | 90 | 9.628905 | 584 | 10.371095 | 10.036135 | 10.407230 | 57 |
| 4 | 9.593067 | 494 | 9.963811 | 90 | 9.629255 | 584 | 10.370745 | 10.036189 | 10.406933 | 56 |
| 5 | 9.593363 | 494 | 9.963757 | 90 | 9.629606 | 583 | 10.370394 | 10.036243 | 10.406637 | 55 |
| 6 | 9.593659 | 493 | 9.963704 | 90 | 9.629956 | 583 | 10.370044 | 10.036296 | 10.406341 | 54 |
| 7 | 9.593955 | 493 | 9.963650 | 90 | 9.630306 | 583 | 10.369694 | 10.036350 | 10.406045 | 53 |
| 8 | 9.594251 | 493 | 9.963596 | 90 | 9.630656 | 583 | 10.369344 | 10.036404 | 10.405749 | 52 |
| 9 | 9.594547 | 492 | 9.963542 | 90 | 9.631005 | 582 | 10.368995 | 10.036458 | 10.405453 | 51 |
| 10 | 9.594842 | 492 | 9.963488 | 90 | 9.631355 | 582 | 10.368645 | 10.036512 | 10.405158 | 50 |
| 11 | 9.595137 | 491 | 9.963434 | 90 | 9.631704 | 582 | 10.368296 | 10.036566 | 10.404863 | 49 |
| 12 | 9.595432 | 491 | 9.963379 | 90 | 9.632053 | 581 | 10.367947 | 10.036621 | 10.404568 | 48 |
| 13 | 9.595727 | 491 | 9.963325 | 90 | 9.632401 | 581 | 10.367599 | 10.036675 | 10.404273 | 47 |
| 14 | 9.596021 | 490 | 9.963271 | 90 | 9.632750 | 581 | 10.367250 | 10.036729 | 10.403979 | 46 |
| 15 | 9.596315 | 490 | 9.963217 | 90 | 9.633098 | 580 | 10.366902 | 10.036783 | 10.403685 | 45 |
| 16 | 9.596609 | 489 | 9.963163 | 90 | 9.633447 | 580 | 10.366553 | 10.036837 | 10.403391 | 44 |
| 17 | 9.596903 | 489 | 9.963108 | 91 | 9.633795 | 580 | 10.366205 | 10.036892 | 10.403097 | 43 |
| 18 | 9.597196 | 489 | 9.963054 | 91 | 9.634143 | 579 | 10.365857 | 10.036946 | 10.402804 | 42 |
| 19 | 9.597490 | 488 | 9.962999 | 91 | 9.634490 | 579 | 10.365510 | 10.037001 | 10.402510 | 41 |
| 20 | 9.597783 | 488 | 9.962945 | 91 | 9.634838 | 579 | 10.365162 | 10.037055 | 10.402217 | 40 |
| 21 | 9.598075 | 487 | 9.962890 | 91 | 9.635185 | 578 | 10.364815 | 10.037110 | 10.401925 | 39 |
| 22 | 9.598368 | 487 | 9.962836 | 91 | 9.635532 | 578 | 10.364468 | 10.037164 | 10.401632 | 38 |
| 23 | 9.598660 | 487 | 9.962781 | 91 | 9.635879 | 578 | 10.364121 | 10.037219 | 10.401340 | 37 |
| 24 | 9.598952 | 486 | 9.962727 | 91 | 9.636226 | 577 | 10.363774 | 10.037273 | 10.401048 | 36 |
| 25 | 9.599244 | 486 | 9.962672 | 91 | 9.636572 | 577 | 10.363428 | 10.037328 | 10.400756 | 35 |
| 26 | 9.599536 | 485 | 9.962617 | 91 | 9.636919 | 577 | 10.363081 | 10.037383 | 10.400464 | 34 |
| 27 | 9.599827 | 485 | 9.962562 | 91 | 9.637265 | 577 | 10.362735 | 10.037438 | 10.400173 | 33 |
| 28 | 9.600118 | 485 | 9.962508 | 91 | 9.637611 | 576 | 10.362389 | 10.037492 | 10.399882 | 32 |
| 29 | 9.600409 | 484 | 9.962453 | 91 | 9.637956 | 576 | 10.362044 | 10.037547 | 10.399591 | 31 |
| 30 | 9.600700 | 484 | 9.962398 | 92 | 9.638302 | 576 | 10.361698 | 10.037602 | 10.399300 | 30 |
| 31 | 9.600990 | 484 | 9.962343 | 92 | 9.638647 | 575 | 10.361353 | 10.037657 | 10.399010 | 29 |
| 32 | 9.601280 | 483 | 9.962288 | 92 | 9.638992 | 575 | 10.361008 | 10.037712 | 10.398720 | 28 |
| 33 | 9.601570 | 483 | 9.962233 | 92 | 9.639337 | 575 | 10.360663 | 10.037767 | 10.398430 | 27 |
| 34 | 9.601860 | 482 | 9.962178 | 92 | 9.639682 | 574 | 10.360318 | 10.037822 | 10.398140 | 26 |
| 35 | 9.602150 | 482 | 9.962123 | 92 | 9.640027 | 574 | 10.359973 | 10.037877 | 10.397850 | 25 |
| 36 | 9.602439 | 482 | 9.962067 | 92 | 9.640371 | 574 | 10.359629 | 10.037933 | 10.397561 | 24 |
| 37 | 9.602728 | 481 | 9.962012 | 92 | 9.640716 | 573 | 10.359284 | 10.037988 | 10.397272 | 23 |
| 38 | 9.603017 | 481 | 9.961957 | 92 | 9.641060 | 573 | 10.358940 | 10.038043 | 10.396983 | 22 |
| 39 | 9.603305 | 481 | 9.961902 | 92 | 9.641404 | 573 | 10.358596 | 10.038098 | 10.396695 | 21 |
| 40 | 9.603594 | 480 | 9.961846 | 92 | 9.641747 | 572 | 10.358253 | 10.038154 | 10.396406 | 20 |
| 41 | 9.603882 | 480 | 9.961791 | 92 | 9.642091 | 572 | 10.357909 | 10.038209 | 10.396118 | 19 |
| 42 | 9.604170 | 479 | 9.961735 | 92 | 9.642434 | 572 | 10.357566 | 10.038265 | 10.395830 | 18 |
| 43 | 9.604457 | 479 | 9.961680 | 92 | 9.642777 | 572 | 10.357223 | 10.038320 | 10.395543 | 17 |
| 44 | 9.604745 | 479 | 9.961624 | 93 | 9.643120 | 571 | 10.356880 | 10.038376 | 10.395255 | 16 |
| 45 | 9.605032 | 478 | 9.961569 | 93 | 9.643463 | 571 | 10.356537 | 10.038431 | 10.394968 | 15 |
| 46 | 9.605319 | 478 | 9.961513 | 93 | 9.643806 | 571 | 10.356194 | 10.038487 | 10.394681 | 14 |
| 47 | 9.605606 | 478 | 9.961458 | 93 | 9.644148 | 570 | 10.355852 | 10.038542 | 10.394394 | 13 |
| 48 | 9.605892 | 477 | 9.961402 | 93 | 9.644490 | 570 | 10.355510 | 10.038598 | 10.394108 | 12 |
| 49 | 9.606179 | 477 | 9.961346 | 93 | 9.644832 | 570 | 10.355168 | 10.038654 | 10.393821 | 11 |
| 50 | 9.606465 | 476 | 9.961290 | 93 | 9.645174 | 570 | 10.354826 | 10.038710 | 10.393535 | 10 |
| 51 | 9.606751 | 476 | 9.961235 | 93 | 9.645516 | 569 | 10.354484 | 10.038765 | 10.393249 | 9 |
| 52 | 9.607036 | 476 | 9.961179 | 93 | 9.645857 | 569 | 10.354143 | 10.038821 | 10.392964 | 8 |
| 53 | 9.607322 | 475 | 9.961123 | 93 | 9.646199 | 569 | 10.353801 | 10.038877 | 10.392678 | 7 |
| 54 | 9.607607 | 475 | 9.961067 | 93 | 9.646540 | 568 | 10.353460 | 10.038933 | 10.392393 | 6 |
| 55 | 9.607892 | 474 | 9.961011 | 93 | 9.646881 | 568 | 10.353119 | 10.038989 | 10.392108 | 5 |
| 56 | 9.608177 | 474 | 9.960955 | 93 | 9.647222 | 568 | 10.352778 | 10.039045 | 10.391823 | 4 |
| 57 | 9.608461 | 474 | 9.960899 | 93 | 9.647562 | 567 | 10.352438 | 10.039101 | 10.391539 | 3 |
| 58 | 9.608745 | 473 | 9.960843 | 94 | 9.647903 | 567 | 10.352097 | 10.039157 | 10.391255 | 2 |
| 59 | 9.609029 | 473 | 9.960786 | 94 | 9.648243 | 567 | 10.351757 | 10.039214 | 10.390971 | 1 |
| 60 | 9.609313 | | 9.960730 | | 9.648583 | | 10.351417 | 10.039270 | 10.390687 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

### 66 Degrees.

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24 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.609313 | 473 | 9.960730 | 94 | 9.648583 | 566 | 10.351417 | 10.039270 | 10.390687 | 60 |
| 1 | 9.609597 | 472 | 9.960674 | 94 | 9.648923 | 566 | 10.351077 | 10.039326 | 10.390403 | 59 |
| 2 | 9.609880 | 472 | 9.960618 | 94 | 9.649263 | 566 | 10.350737 | 10.039382 | 10.390120 | 58 |
| 3 | 9.610164 | 472 | 9.960561 | 94 | 9.649602 | 566 | 10.350398 | 10.039439 | 10.389836 | 57 |
| 4 | 9.610447 | 471 | 9.960505 | 94 | 9.649942 | 565 | 10.350058 | 10.039495 | 10.389553 | 56 |
| 5 | 9.610729 | 471 | 9.960448 | 94 | 9.650281 | 565 | 10.349719 | 10.039552 | 10.389271 | 55 |
| 6 | 9.611012 | 470 | 9.960392 | 94 | 9.650620 | 565 | 10.349380 | 10.039608 | 10.388988 | 54 |
| 7 | 9.611294 | 470 | 9.960335 | 94 | 9.650959 | 564 | 10.349041 | 10.039665 | 10.388706 | 53 |
| 8 | 9.611576 | 470 | 9.960279 | 94 | 9.651297 | 564 | 10.348703 | 10.039721 | 10.388424 | 52 |
| 9 | 9.611858 | 469 | 9.960222 | 94 | 9.651636 | 564 | 10.348364 | 10.039778 | 10.388142 | 51 |
| 10 | 9.612140 | 469 | 9.960165 | 94 | 9.651974 | 563 | 10.348026 | 10.039835 | 10.387860 | 50 |
| 11 | 9.612421 | 469 | 9.960109 | 95 | 9.652312 | 563 | 10.347688 | 10.039891 | 10.387579 | 49 |
| 12 | 9.612702 | 468 | 9.960052 | 95 | 9.652650 | 563 | 10.347350 | 10.039948 | 10.387298 | 48 |
| 13 | 9.612983 | 468 | 9.959995 | 95 | 9.652988 | 563 | 10.347012 | 10.040005 | 10.387017 | 47 |
| 14 | 9.613264 | 467 | 9.959938 | 95 | 9.653326 | 562 | 10.346674 | 10.040062 | 10.386736 | 46 |
| 15 | 9.613545 | 467 | 9.959882 | 95 | 9.653663 | 562 | 10.346337 | 10.040118 | 10.386455 | 45 |
| 16 | 9.613825 | 467 | 9.959825 | 95 | 9.654000 | 562 | 10.346000 | 10.040175 | 10.386175 | 44 |
| 17 | 9.614105 | 466 | 9.959768 | 95 | 9.654337 | 561 | 10.345663 | 10.040232 | 10.385895 | 43 |
| 18 | 9.614385 | 466 | 9.959711 | 95 | 9.654674 | 561 | 10.345326 | 10.040289 | 10.385615 | 42 |
| 19 | 9.614665 | 466 | 9.959654 | 95 | 9.655011 | 561 | 10.344989 | 10.040346 | 10.385335 | 41 |
| 20 | 9.614944 | 465 | 9.959596 | 95 | 9.655348 | 561 | 10.344652 | 10.040404 | 10.385056 | 40 |
| 21 | 9.615223 | 465 | 9.959539 | 95 | 9.655684 | 560 | 10.344316 | 10.040461 | 10.384777 | 39 |
| 22 | 9.615502 | 465 | 9.959482 | 95 | 9.656020 | 560 | 10.343980 | 10.040518 | 10.384498 | 38 |
| 23 | 9.615781 | 464 | 9.959425 | 95 | 9.656356 | 560 | 10.343644 | 10.040575 | 10.384219 | 37 |
| 24 | 9.616060 | 464 | 9.959368 | 95 | 9.656692 | 559 | 10.343308 | 10.040632 | 10.383940 | 36 |
| 25 | 9.616338 | 464 | 9.959310 | 96 | 9.657028 | 559 | 10.342972 | 10.040690 | 10.383662 | 35 |
| 26 | 9.616616 | 463 | 9.959253 | 96 | 9.657364 | 559 | 10.342636 | 10.040747 | 10.383384 | 34 |
| 27 | 9.616894 | 463 | 9.959195 | 96 | 9.657699 | 559 | 10.342301 | 10.040805 | 10.383106 | 33 |
| 28 | 9.617172 | 462 | 9.959138 | 96 | 9.658034 | 558 | 10.341966 | 10.040862 | 10.382828 | 32 |
| 29 | 9.617450 | 462 | 9.959080 | 96 | 9.658369 | 558 | 10.341631 | 10.040919 | 10.382550 | 31 |
| 30 | 9.617727 | 462 | 9.959023 | 96 | 9.658704 | 558 | 10.341296 | 10.040977 | 10.382273 | 30 |
| 31 | 9.618004 | 461 | 9.958965 | 96 | 9.659039 | 558 | 10.340961 | 10.041035 | 10.381996 | 29 |
| 32 | 9.618281 | 461 | 9.958908 | 96 | 9.659373 | 557 | 10.340627 | 10.041092 | 10.381719 | 28 |
| 33 | 9.618558 | 461 | 9.958850 | 96 | 9.659708 | 557 | 10.340292 | 10.041150 | 10.381442 | 27 |
| 34 | 9.618834 | 460 | 9.958792 | 96 | 9.660042 | 557 | 10.339958 | 10.041208 | 10.381166 | 26 |
| 35 | 9.619110 | 460 | 9.958734 | 96 | 9.660376 | 556 | 10.339624 | 10.041266 | 10.380890 | 25 |
| 36 | 9.619386 | 460 | 9.958677 | 96 | 9.660710 | 556 | 10.339290 | 10.041323 | 10.380614 | 24 |
| 37 | 9.619662 | 459 | 9.958619 | 96 | 9.661013 | 556 | 10.338957 | 10.041381 | 10.380338 | 23 |
| 38 | 9.619938 | 459 | 9.958561 | 96 | 9.661377 | 556 | 10.338623 | 10.041439 | 10.380062 | 22 |
| 39 | 9.620213 | 459 | 9.958503 | 97 | 9.661710 | 555 | 10.338290 | 10.041497 | 10.379787 | 21 |
| 40 | 9.620488 | 458 | 9.958445 | 97 | 9.662043 | 555 | 10.337957 | 10.041555 | 10.379512 | 20 |
| 41 | 9.620763 | 458 | 9.958387 | 97 | 9.662376 | 555 | 10.337624 | 10.041613 | 10.379237 | 19 |
| 42 | 9.621038 | 457 | 9.958329 | 97 | 9.662709 | 554 | 10.337291 | 10.041671 | 10.378962 | 18 |
| 43 | 9.621313 | 457 | 9.958271 | 97 | 9.663042 | 554 | 10.336958 | 10.041729 | 10.378687 | 17 |
| 44 | 9.621587 | 457 | 9.958213 | 97 | 9.663375 | 554 | 10.336625 | 10.041787 | 10.378413 | 16 |
| 45 | 9.621861 | 456 | 9.958154 | 97 | 9.663707 | 554 | 10.336293 | 10.041846 | 10.378139 | 15 |
| 46 | 9.622135 | 456 | 9.958096 | 97 | 9.664039 | 553 | 10.335961 | 10.041904 | 10.377865 | 14 |
| 47 | 9.622409 | 456 | 9.958038 | 97 | 9.664371 | 553 | 10.335629 | 10.041962 | 10.377591 | 13 |
| 48 | 9.622682 | 455 | 9.957979 | 97 | 9.664703 | 553 | 10.335297 | 10.042021 | 10.377318 | 12 |
| 49 | 9.622956 | 455 | 9.957921 | 97 | 9.665035 | 553 | 10.334965 | 10.042079 | 10.377044 | 11 |
| 50 | 9.623229 | 455 | 9.957863 | 97 | 9.665366 | 552 | 10.334634 | 10.042137 | 10.376771 | 10 |
| 51 | 9.623502 | 454 | 9.957804 | 97 | 9.665697 | 552 | 10.334303 | 10.042196 | 10.376498 | 9 |
| 52 | 9.623774 | 454 | 9.957746 | 98 | 9.666029 | 552 | 10.333971 | 10.042254 | 10.376226 | 8 |
| 53 | 9.624047 | 454 | 9.957687 | 98 | 9.666360 | 551 | 10.333640 | 10.042313 | 10.375953 | 7 |
| 54 | 9.624319 | 453 | 9.957628 | 98 | 9.666691 | 551 | 10.333309 | 10.042372 | 10.375681 | 6 |
| 55 | 9.624591 | 453 | 9.957570 | 98 | 9.667021 | 551 | 10.332979 | 10.042430 | 10.375409 | 5 |
| 56 | 9.624863 | 453 | 9.957511 | 98 | 9.667352 | 551 | 10.332648 | 10.042489 | 10.375137 | 4 |
| 57 | 9.625135 | 452 | 9.957452 | 98 | 9.667682 | 550 | 10.332318 | 10.042548 | 10.374865 | 3 |
| 58 | 9.625406 | 452 | 9.957393 | 98 | 9.668013 | 550 | 10.331987 | 10.042607 | 10.374594 | 2 |
| 59 | 9.625677 | 452 | 9.957335 | 98 | 9.668343 | 550 | 10.331657 | 10.042665 | 10.374323 | 1 |
| 60 | 9.625948 | | 9.957276 | | 9.668672 | | 10.331328 | 10.042724 | 10.374052 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

65 Degrees.

## 25 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.625948 | | 9.957276 | | 9.668673 | | 10.331327 | 10.042724 | 10.374052 | 60 |
| 1 | 9.626219 | 451 | 9.957217 | 98 | 9.669002 | 550 | 10.330998 | 10.042783 | 10.373781 | 59 |
| 2 | 9.626490 | 451 | 9.957158 | 98 | 9.669332 | 549 | 10.330668 | 10.042842 | 10.373510 | 58 |
| 3 | 9.626760 | 450 | 9.957099 | 98 | 9.669661 | 549 | 10.330339 | 10.042901 | 10.373240 | 57 |
| 4 | 9.627030 | 450 | 9.957040 | 98 | 9.669991 | 548 | 10.330009 | 10.042960 | 10.372970 | 56 |
| 5 | 9.627300 | 450 | 9.956981 | 98 | 9.670320 | 548 | 10.329680 | 10.043019 | 10.372700 | 55 |
| 6 | 9.627570 | 449 | 9.956921 | 99 | 9.670649 | 548 | 10.329351 | 10.043079 | 10.372430 | 54 |
| 7 | 9.627840 | 449 | 9.956862 | 99 | 9.670977 | 548 | 10.329023 | 10.043138 | 10.372160 | 53 |
| 8 | 9.628109 | 449 | 9.956803 | 99 | 9.671306 | 547 | 10.328694 | 10.043197 | 10.371891 | 52 |
| 9 | 9.628378 | 448 | 9.956744 | 99 | 9.671634 | 547 | 10.328366 | 10.043256 | 10.371622 | 51 |
| 10 | 9.628647 | 448 | 9.956684 | 99 | 9.671963 | 547 | 10.328037 | 10.043316 | 10.371353 | 50 |
| 11 | 9.628916 | 447 | 9.956625 | 99 | 9.672291 | 547 | 10.327709 | 10.043375 | 10.371084 | 49 |
| 12 | 9.629185 | 447 | 9.956566 | 99 | 9.672619 | 546 | 10.327381 | 10.043434 | 10.370815 | 48 |
| 13 | 9.629453 | 447 | 9.956506 | 99 | 9.672947 | 546 | 10.327053 | 10.043494 | 10.370547 | 47 |
| 14 | 9.629721 | 446 | 9.956447 | 99 | 9.673274 | 546 | 10.326726 | 10.043553 | 10.370279 | 46 |
| 15 | 9.629989 | 446 | 9.956387 | 99 | 9.673602 | 546 | 10.326398 | 10.043613 | 10.370011 | 45 |
| 16 | 9.630257 | 446 | 9.956327 | 99 | 9.673929 | 545 | 10.326071 | 10.043673 | 10.369743 | 44 |
| 17 | 9.630524 | 446 | 9.956268 | 99 | 9.674257 | 545 | 10.325743 | 10.043732 | 10.369476 | 43 |
| 18 | 9.630792 | 445 | 9.956208 | 100 | 9.674584 | 545 | 10.325416 | 10.043792 | 10.369208 | 42 |
| 19 | 9.631059 | 445 | 9.956148 | 100 | 9.674910 | 544 | 10.325090 | 10.043852 | 10.368941 | 41 |
| 20 | 9.631326 | 445 | 9.956089 | 100 | 9.675237 | 544 | 10.324763 | 10.043911 | 10.368674 | 40 |
| 21 | 9.631593 | 444 | 9.956029 | 100 | 9.675564 | 544 | 10.324436 | 10.043971 | 10.368407 | 39 |
| 22 | 9.631859 | 444 | 9.955969 | 100 | 9.675890 | 544 | 10.324110 | 10.044031 | 10.368141 | 38 |
| 23 | 9.632125 | 444 | 9.955909 | 100 | 9.676217 | 543 | 10.323783 | 10.044091 | 10.367875 | 37 |
| 24 | 9.632392 | 443 | 9.955849 | 100 | 9.676543 | 543 | 10.323457 | 10.044151 | 10.367608 | 36 |
| 25 | 9.632658 | 443 | 9.955789 | 100 | 9.676869 | 543 | 10.323131 | 10.044211 | 10.367342 | 35 |
| 26 | 9.632923 | 443 | 9.955729 | 100 | 9.677194 | 543 | 10.322806 | 10.044271 | 10.367077 | 34 |
| 27 | 9.633189 | 442 | 9.955669 | 100 | 9.677520 | 542 | 10.322480 | 10.044331 | 10.366811 | 33 |
| 28 | 9.633454 | 442 | 9.955609 | 100 | 9.677846 | 542 | 10.322154 | 10.044391 | 10.366546 | 32 |
| 29 | 9.633719 | 442 | 9.955548 | 100 | 9.678171 | 542 | 10.321829 | 10.044452 | 10.366281 | 31 |
| 30 | 9.633984 | 441 | 9.955488 | 100 | 9.678496 | 542 | 10.321504 | 10.044512 | 10.366016 | 30 |
| 31 | 9.634249 | 441 | 9.955428 | 101 | 9.678821 | 541 | 10.321179 | 10.044572 | 10.365751 | 29 |
| 32 | 9.634514 | 440 | 9.955368 | 101 | 9.679146 | 541 | 10.320854 | 10.044632 | 10.365486 | 28 |
| 33 | 9.634778 | 440 | 9.955307 | 101 | 9.679471 | 541 | 10.320529 | 10.044693 | 10.365222 | 27 |
| 34 | 9.635042 | 440 | 9.955247 | 101 | 9.679795 | 541 | 10.320205 | 10.044753 | 10.364958 | 26 |
| 35 | 9.635306 | 439 | 9.955186 | 101 | 9.680120 | 540 | 10.319880 | 10.044814 | 10.364694 | 25 |
| 36 | 9.635570 | 439 | 9.955126 | 101 | 9.680444 | 540 | 10.319556 | 10.044874 | 10.364430 | 24 |
| 37 | 9.635834 | 439 | 9.955065 | 101 | 9.680768 | 540 | 10.319232 | 10.044935 | 10.364166 | 23 |
| 38 | 9.636097 | 438 | 9.955005 | 101 | 9.681092 | 540 | 10.318908 | 10.044995 | 10.363903 | 22 |
| 39 | 9.636360 | 438 | 9.954944 | 101 | 9.681416 | 539 | 10.318584 | 10.045056 | 10.363640 | 21 |
| 40 | 9.636623 | 438 | 9.954883 | 101 | 9.681740 | 539 | 10.318260 | 10.045117 | 10.363377 | 20 |
| 41 | 9.636886 | 437 | 9.954823 | 101 | 9.682063 | 539 | 10.317937 | 10.045177 | 10.363114 | 19 |
| 42 | 9.637148 | 437 | 9.954762 | 101 | 9.682387 | 539 | 10.317613 | 10.045238 | 10.362852 | 18 |
| 43 | 9.637411 | 437 | 9.954701 | 101 | 9.682710 | 538 | 10.317290 | 10.045299 | 10.362589 | 17 |
| 44 | 9.637673 | 437 | 9.954640 | 101 | 9.683033 | 538 | 10.316967 | 10.045360 | 10.362327 | 16 |
| 45 | 9.637935 | 436 | 9.954579 | 101 | 9.683356 | 538 | 10.316644 | 10.045421 | 10.362065 | 15 |
| 46 | 9.638197 | 436 | 9.954518 | 102 | 9.683679 | 538 | 10.316321 | 10.045482 | 10.361803 | 14 |
| 47 | 9.638458 | 436 | 9.954457 | 102 | 9.684001 | 537 | 10.315999 | 10.045543 | 10.361542 | 13 |
| 48 | 9.638720 | 435 | 9.954396 | 102 | 9.684324 | 537 | 10.315676 | 10.045604 | 10.361280 | 12 |
| 49 | 9.638981 | 435 | 9.954335 | 102 | 9.684646 | 537 | 10.315354 | 10.045665 | 10.361019 | 11 |
| 50 | 9.639242 | 435 | 9.954274 | 102 | 9.684968 | 537 | 10.315032 | 10.045726 | 10.360758 | 10 |
| 51 | 9.639503 | 434 | 9.954213 | 102 | 9.685290 | 536 | 10.314710 | 10.045787 | 10.360497 | 9 |
| 52 | 9.639764 | 434 | 9.954152 | 102 | 9.685612 | 536 | 10.314388 | 10.045848 | 10.360236 | 8 |
| 53 | 9.640024 | 434 | 9.954090 | 102 | 9.685934 | 536 | 10.314066 | 10.045910 | 10.359976 | 7 |
| 54 | 9.640284 | 433 | 9.954029 | 102 | 9.686255 | 536 | 10.313745 | 10.045971 | 10.359716 | 6 |
| 55 | 9.640544 | 433 | 9.953968 | 102 | 9.686577 | 535 | 10.313423 | 10.046032 | 10.359456 | 5 |
| 56 | 9.640804 | 433 | 9.953906 | 102 | 9.686898 | 535 | 10.313102 | 10.046094 | 10.359196 | 4 |
| 57 | 9.641064 | 433 | 9.953845 | 102 | 9.687219 | 535 | 10.312781 | 10.046155 | 10.358936 | 3 |
| 58 | 9.641324 | 432 | 9.953783 | 102 | 9.687540 | 535 | 10.312460 | 10.046217 | 10.358676 | 2 |
| 59 | 9.641583 | 432 | 9.953722 | 103 | 9.687861 | 534 | 10.312139 | 10.046278 | 10.358417 | 1 |
| 60 | 9.641842 | | 9.953660 | | 9.688182 | | 10.311818 | 10.046340 | 10.358158 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 64 Degrees.

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## 26 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.641842 | 431 | 9.953660 | 103 | 9.688182 | 534 | 10.311818 | 10.046340 | 10.358158 | 60 |
| 1 | 9.642101 | 431 | 9.953599 | 103 | 9.688502 | 534 | 10.311498 | 10.046401 | 10.357899 | 59 |
| 2 | 9.642360 | 431 | 9.953537 | 103 | 9.688823 | 534 | 10.311177 | 10.046463 | 10.357640 | 58 |
| 3 | 9.642618 | 430 | 9.953475 | 103 | 9.689143 | 533 | 10.310857 | 10.046525 | 10.357382 | 57 |
| 4 | 9.642877 | 430 | 9.953413 | 103 | 9.689463 | 533 | 10.310537 | 10.046587 | 10.357123 | 56 |
| 5 | 9.643135 | 430 | 9.953352 | 103 | 9.689783 | 533 | 10.310217 | 10.046648 | 10.356865 | 55 |
| 6 | 9.643393 | 430 | 9.953290 | 103 | 9.690103 | 533 | 10.309897 | 10.046710 | 10.356607 | 54 |
| 7 | 9.643650 | 429 | 9.953228 | 103 | 9.690423 | 533 | 10.309577 | 10.046772 | 10.356350 | 53 |
| 8 | 9.643908 | 429 | 9.953166 | 103 | 9.690742 | 532 | 10.309258 | 10.046834 | 10.356092 | 52 |
| 9 | 9.644165 | 429 | 9.953104 | 103 | 9.691062 | 532 | 10.308938 | 10.046896 | 10.355835 | 51 |
| 10 | 9.644423 | 428 | 9.953042 | 103 | 9.691381 | 532 | 10.308619 | 10.046958 | 10.355577 | 50 |
| 11 | 9.644680 | 428 | 9.952980 | 104 | 9.691700 | 531 | 10.308300 | 10.047020 | 10.355320 | 49 |
| 12 | 9.644936 | 428 | 9.952918 | 104 | 9.692019 | 531 | 10.307981 | 10.047082 | 10.355064 | 48 |
| 13 | 9.645193 | 427 | 9.952855 | 104 | 9.692338 | 531 | 10.307662 | 10.047145 | 10.354807 | 47 |
| 14 | 9.645450 | 427 | 9.952793 | 104 | 9.692656 | 531 | 10.307344 | 10.047207 | 10.354550 | 46 |
| 15 | 9.645706 | 427 | 9.952731 | 104 | 9.692975 | 531 | 10.307025 | 10.047269 | 10.354294 | 45 |
| 16 | 9.645962 | 426 | 9.952669 | 104 | 9.693293 | 530 | 10.306707 | 10.047331 | 10.354038 | 44 |
| 17 | 9.646218 | 426 | 9.952606 | 104 | 9.693612 | 530 | 10.306388 | 10.047394 | 10.353782 | 43 |
| 18 | 9.646474 | 426 | 9.952544 | 104 | 9.693930 | 530 | 10.306070 | 10.047456 | 10.353526 | 42 |
| 19 | 9.646729 | 425 | 9.952481 | 104 | 9.694248 | 530 | 10.305752 | 10.047519 | 10.353271 | 41 |
| 20 | 9.646984 | 425 | 9.952419 | 104 | 9.694566 | 529 | 10.305434 | 10.047581 | 10.353016 | 40 |
| 21 | 9.647240 | 425 | 9.952356 | 104 | 9.694883 | 529 | 10.305117 | 10.047644 | 10.352760 | 39 |
| 22 | 9.647494 | 424 | 9.952294 | 104 | 9.695201 | 529 | 10.304799 | 10.047706 | 10.352506 | 38 |
| 23 | 9.647749 | 424 | 9.952231 | 104 | 9.695518 | 529 | 10.304482 | 10.047769 | 10.352251 | 37 |
| 24 | 9.648004 | 424 | 9.952168 | 104 | 9.695836 | 529 | 10.304164 | 10.047832 | 10.351996 | 36 |
| 25 | 9.648258 | 424 | 9.952106 | 105 | 9.696153 | 528 | 10.303847 | 10.047894 | 10.351742 | 35 |
| 26 | 9.648512 | 423 | 9.952043 | 105 | 9.696470 | 528 | 10.303530 | 10.047957 | 10.351488 | 34 |
| 27 | 9.648766 | 423 | 9.951980 | 105 | 9.696787 | 528 | 10.303213 | 10.048020 | 10.351234 | 33 |
| 28 | 9.649020 | 423 | 9.951917 | 105 | 9.697103 | 528 | 10.302897 | 10.048083 | 10.350980 | 32 |
| 29 | 9.649274 | 422 | 9.951854 | 105 | 9.697420 | 527 | 10.302580 | 10.048146 | 10.350726 | 31 |
| 30 | 9.649527 | 422 | 9.951791 | 105 | 9.697736 | 527 | 10.302264 | 10.048209 | 10.350473 | 30 |
| 31 | 9.649781 | 422 | 9.951728 | 105 | 9.698053 | 527 | 10.301947 | 10.048272 | 10.350219 | 29 |
| 32 | 9.650034 | 422 | 9.951665 | 105 | 9.698369 | 527 | 10.301631 | 10.048335 | 10.349966 | 28 |
| 33 | 9.650287 | 421 | 9.951602 | 105 | 9.698685 | 526 | 10.301315 | 10.048398 | 10.349713 | 27 |
| 34 | 9.650539 | 421 | 9.951539 | 105 | 9.699001 | 526 | 10.300999 | 10.048461 | 10.349461 | 26 |
| 35 | 9.650792 | 421 | 9.951476 | 105 | 9.699316 | 526 | 10.300684 | 10.048524 | 10.349208 | 25 |
| 36 | 9.651044 | 420 | 9.951412 | 105 | 9.699632 | 526 | 10.300368 | 10.048588 | 10.348956 | 24 |
| 37 | 9.651297 | 420 | 9.951349 | 106 | 9.699947 | 526 | 10.300053 | 10.048651 | 10.348703 | 23 |
| 38 | 9.651549 | 420 | 9.951286 | 106 | 9.700263 | 525 | 10.299737 | 10.048714 | 10.348451 | 22 |
| 39 | 9.651800 | 419 | 9.951222 | 106 | 9.700578 | 525 | 10.299422 | 10.048778 | 10.348200 | 21 |
| 40 | 9.652052 | 419 | 9.951159 | 106 | 9.700893 | 525 | 10.299107 | 10.048841 | 10.347948 | 20 |
| 41 | 9.652304 | 419 | 9.951096 | 106 | 9.701208 | 525 | 10.298792 | 10.048904 | 10.347696 | 19 |
| 42 | 9.652555 | 418 | 9.951032 | 106 | 9.701523 | 524 | 10.298477 | 10.048968 | 10.347445 | 18 |
| 43 | 9.652806 | 418 | 9.950968 | 106 | 9.701837 | 524 | 10.298163 | 10.049032 | 10.347194 | 17 |
| 44 | 9.653057 | 418 | 9.950905 | 106 | 9.702152 | 524 | 10.297848 | 10.049095 | 10.346943 | 16 |
| 45 | 9.653308 | 418 | 9.950841 | 106 | 9.702466 | 524 | 10.297534 | 10.049159 | 10.346692 | 15 |
| 46 | 9.653558 | 417 | 9.950778 | 106 | 9.702780 | 523 | 10.297220 | 10.049222 | 10.346442 | 14 |
| 47 | 9.653808 | 417 | 9.950714 | 106 | 9.703095 | 523 | 10.296905 | 10.049286 | 10.346192 | 13 |
| 48 | 9.654059 | 417 | 9.950650 | 106 | 9.703409 | 523 | 10.296591 | 10.049350 | 10.345941 | 12 |
| 49 | 9.654309 | 416 | 9.950586 | 106 | 9.703723 | 523 | 10.296277 | 10.049414 | 10.345691 | 11 |
| 50 | 9.654558 | 416 | 9.950522 | 106 | 9.704036 | 523 | 10.295964 | 10.049478 | 10.345442 | 10 |
| 51 | 9.654808 | 416 | 9.950458 | 107 | 9.704350 | 522 | 10.295650 | 10.049542 | 10.345192 | 9 |
| 52 | 9.655058 | 415 | 9.950394 | 107 | 9.704663 | 522 | 10.295337 | 10.049606 | 10.344942 | 8 |
| 53 | 9.655307 | 415 | 9.950330 | 107 | 9.704977 | 522 | 10.295023 | 10.049670 | 10.344693 | 7 |
| 54 | 9.655556 | 415 | 9.950266 | 107 | 9.705290 | 522 | 10.294710 | 10.049734 | 10.344444 | 6 |
| 55 | 9.655805 | 415 | 9.950202 | 107 | 9.705603 | 521 | 10.294397 | 10.049798 | 10.344195 | 5 |
| 56 | 9.656054 | 414 | 9.950138 | 107 | 9.705916 | 521 | 10.294084 | 10.049862 | 10.343946 | 4 |
| 57 | 9.656302 | 414 | 9.950074 | 107 | 9.706228 | 521 | 10.293772 | 10.049926 | 10.343698 | 3 |
| 58 | 9.656551 | 414 | 9.950010 | 107 | 9.706541 | 521 | 10.293459 | 10.049990 | 10.343449 | 2 |
| 59 | 9.656799 | 413 | 9.949945 | 107 | 9.706854 | 521 | 10.293146 | 10.050055 | 10.343201 | 1 |
| 60 | 9.657047 | | 9.949881 | | 9.707166 | | 10.292834 | 10.050119 | 10.342953 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 63 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 27 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.657047 | 413 | 9.949881 | 107 | 9.707166 | 520 | 10.292834 | 10.050119 | 10.342953 | 60 |
| 1 | 9.657295 | 413 | 9.949816 | 107 | 9.707478 | 520 | 10.292522 | 10.050184 | 10.342705 | 59 |
| 2 | 9.657542 | 412 | 9.949752 | 107 | 9.707790 | 520 | 10.292210 | 10.050248 | 10.342458 | 58 |
| 3 | 9.657790 | 412 | 9.949688 | 108 | 9.708102 | 520 | 10.291898 | 10.050312 | 10.342210 | 57 |
| 4 | 9.658037 | 412 | 9.949623 | 108 | 9.708414 | 519 | 10.291586 | 10.050377 | 10.341963 | 56 |
| 5 | 9.658284 | 412 | 9.949558 | 108 | 9.708726 | 519 | 10.291274 | 10.050442 | 10.341716 | 55 |
| 6 | 9.658531 | 411 | 9.949494 | 108 | 9.709037 | 519 | 10.290963 | 10.050506 | 10.341469 | 54 |
| 7 | 9.658778 | 411 | 9.949429 | 108 | 9.709349 | 519 | 10.290651 | 10.050571 | 10.341222 | 53 |
| 8 | 9.659025 | 411 | 9.949364 | 108 | 9.709660 | 519 | 10.290340 | 10.050636 | 10.340975 | 52 |
| 9 | 9.659271 | 410 | 9.949300 | 108 | 9.709971 | 518 | 10.290029 | 10.050700 | 10.340729 | 51 |
| 10 | 9.659517 | 410 | 9.949235 | 108 | 9.710282 | 518 | 10.289718 | 10.050765 | 10.340483 | 50 |
| 11 | 9.659763 | 410 | 9.949170 | 108 | 9.710593 | 518 | 10.289407 | 10.050830 | 10.340237 | 49 |
| 12 | 9.660009 | 409 | 9.949105 | 108 | 9.710904 | 518 | 10.289096 | 10.050895 | 10.339991 | 48 |
| 13 | 9.660255 | 409 | 9.949040 | 108 | 9.711215 | 518 | 10.288785 | 10.050960 | 10.339745 | 47 |
| 14 | 9.660501 | 409 | 9.948975 | 108 | 9.711525 | 517 | 10.288475 | 10.051025 | 10.339499 | 46 |
| 15 | 9.660746 | 409 | 9.948910 | 108 | 9.711836 | 517 | 10.288164 | 10.051090 | 10.339254 | 45 |
| 16 | 9.660991 | 408 | 9.948845 | 108 | 9.712146 | 517 | 10.287854 | 10.051155 | 10.339009 | 44 |
| 17 | 9.661236 | 408 | 9.948780 | 109 | 9.712456 | 517 | 10.287544 | 10.051220 | 10.338764 | 43 |
| 18 | 9.661481 | 408 | 9.948715 | 109 | 9.712766 | 516 | 10.287234 | 10.051285 | 10.338519 | 42 |
| 19 | 9.661726 | 407 | 9.948650 | 109 | 9.713076 | 516 | 10.286924 | 10.051350 | 10.338274 | 41 |
| 20 | 9.661970 | 407 | 9.948584 | 109 | 9.713386 | 516 | 10.286614 | 10.051416 | 10.338030 | 40 |
| 21 | 9.662214 | 407 | 9.948519 | 109 | 9.713696 | 516 | 10.286304 | 10.051481 | 10.337786 | 39 |
| 22 | 9.662459 | 407 | 9.948454 | 109 | 9.714005 | 516 | 10.285995 | 10.051546 | 10.337541 | 38 |
| 23 | 9.662703 | 406 | 9.948388 | 109 | 9.714314 | 515 | 10.285686 | 10.051612 | 10.337297 | 37 |
| 24 | 9.662946 | 406 | 9.948323 | 109 | 9.714624 | 515 | 10.285376 | 10.051677 | 10.337054 | 36 |
| 25 | 9.663190 | 406 | 9.948257 | 109 | 9.714933 | 515 | 10.285067 | 10.051743 | 10.336810 | 35 |
| 26 | 9.663433 | 405 | 9.948192 | 109 | 9.715242 | 515 | 10.284758 | 10.051808 | 10.336567 | 34 |
| 27 | 9.663677 | 405 | 9.948126 | 109 | 9.715551 | 514 | 10.284449 | 10.051874 | 10.336323 | 33 |
| 28 | 9.663920 | 405 | 9.948060 | 109 | 9.715860 | 514 | 10.284140 | 10.051940 | 10.336080 | 32 |
| 29 | 9.664163 | 405 | 9.947995 | 110 | 9.716168 | 514 | 10.283832 | 10.052005 | 10.335837 | 31 |
| 30 | 9.664406 | 404 | 9.947929 | 110 | 9.716477 | 514 | 10.283523 | 10.052071 | 10.335594 | 30 |
| 31 | 9.664648 | 404 | 9.947863 | 110 | 9.716785 | 514 | 10.283215 | 10.052137 | 10.335352 | 29 |
| 32 | 9.664891 | 404 | 9.947797 | 110 | 9.717093 | 513 | 10.282907 | 10.052203 | 10.335109 | 28 |
| 33 | 9.665133 | 403 | 9.947731 | 110 | 9.717401 | 513 | 10.282599 | 10.052269 | 10.334867 | 27 |
| 34 | 9.665375 | 403 | 9.947665 | 110 | 9.717709 | 513 | 10.282291 | 10.052335 | 10.334625 | 26 |
| 35 | 9.665617 | 403 | 9.947600 | 110 | 9.718017 | 513 | 10.281983 | 10.052400 | 10.334383 | 25 |
| 36 | 9.665859 | 402 | 9.947533 | 110 | 9.718325 | 513 | 10.281675 | 10.052467 | 10.334141 | 24 |
| 37 | 9.666100 | 402 | 9.947467 | 110 | 9.718633 | 512 | 10.281367 | 10.052533 | 10.333900 | 23 |
| 38 | 9.666342 | 402 | 9.947401 | 110 | 9.718940 | 512 | 10.281060 | 10.052599 | 10.333658 | 22 |
| 39 | 9.666583 | 402 | 9.947335 | 110 | 9.719248 | 512 | 10.280752 | 10.052665 | 10.333417 | 21 |
| 40 | 9.666824 | 401 | 9.947269 | 110 | 9.719555 | 512 | 10.280445 | 10.052731 | 10.333176 | 20 |
| 41 | 9.667065 | 401 | 9.947203 | 110 | 9.719862 | 512 | 10.280138 | 10.052797 | 10.332935 | 19 |
| 42 | 9.667305 | 401 | 9.947136 | 111 | 9.720169 | 511 | 10.279831 | 10.052864 | 10.332695 | 18 |
| 43 | 9.667546 | 401 | 9.947070 | 111 | 9.720476 | 511 | 10.279524 | 10.052930 | 10.332454 | 17 |
| 44 | 9.667786 | 400 | 9.947004 | 111 | 9.720783 | 511 | 10.279217 | 10.052996 | 10.332214 | 16 |
| 45 | 9.668027 | 400 | 9.946937 | 111 | 9.721089 | 511 | 10.278911 | 10.053063 | 10.331973 | 15 |
| 46 | 9.668267 | 400 | 9.946871 | 111 | 9.721396 | 511 | 10.278604 | 10.053129 | 10.331733 | 14 |
| 47 | 9.668506 | 399 | 9.946804 | 111 | 9.721702 | 510 | 10.278298 | 10.053196 | 10.331494 | 13 |
| 48 | 9.668746 | 399 | 9.946738 | 111 | 9.722009 | 510 | 10.277991 | 10.053262 | 10.331254 | 12 |
| 49 | 9.668986 | 399 | 9.946671 | 111 | 9.722315 | 510 | 10.277685 | 10.053329 | 10.331014 | 11 |
| 50 | 9.669225 | 399 | 9.946604 | 111 | 9.722621 | 510 | 10.277379 | 10.053396 | 10.330775 | 10 |
| 51 | 9.669464 | 398 | 9.946538 | 111 | 9.722927 | 510 | 10.277073 | 10.053462 | 10.330536 | 9 |
| 52 | 9.669703 | 398 | 9.946471 | 111 | 9.723232 | 509 | 10.276768 | 10.053529 | 10.330297 | 8 |
| 53 | 9.669942 | 398 | 9.946404 | 111 | 9.723538 | 509 | 10.276462 | 10.053596 | 10.330058 | 7 |
| 54 | 9.670181 | 397 | 9.946337 | 111 | 9.723844 | 509 | 10.276156 | 10.053663 | 10.329819 | 6 |
| 55 | 9.670419 | 397 | 9.946270 | 112 | 9.724149 | 509 | 10.275851 | 10.053730 | 10.329581 | 5 |
| 56 | 9.670658 | 397 | 9.946203 | 112 | 9.724454 | 509 | 10.275546 | 10.053797 | 10.329342 | 4 |
| 57 | 9.670896 | 397 | 9.946136 | 112 | 9.724759 | 508 | 10.275241 | 10.053864 | 10.329104 | 3 |
| 58 | 9.671134 | 396 | 9.946069 | 112 | 9.725065 | 508 | 10.274935 | 10.053931 | 10.328866 | 2 |
| 59 | 9.671372 | 396 | 9.946002 | 112 | 9.725369 | 508 | 10.274631 | 10.053998 | 10.328628 | 1 |
| 60 | 9.671609 | | 9.945935 | | 9.725674 | | 10.274326 | 10.054065 | 10.328391 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

28 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.671600 | 396 | 9.945935 | 112 | 9.725674 | 508 | 10.274326 | 10.054065 | 10.328391 | 60 |
| 1 | 9.671847 | 395 | 9.945868 | 112 | 9.725979 | 508 | 10.274021 | 10.054132 | 10.328153 | 59 |
| 2 | 9.672084 | 395 | 9.945800 | 112 | 9.726284 | 507 | 10.273716 | 10.054200 | 10.327916 | 58 |
| 3 | 9.672321 | 395 | 9.945733 | 112 | 9.726588 | 507 | 10.273412 | 10.054267 | 10.327679 | 57 |
| 4 | 9.672558 | 395 | 9.945666 | 112 | 9.726892 | 507 | 10.273108 | 10.054334 | 10.327442 | 56 |
| 5 | 9.672795 | 394 | 9.945598 | 112 | 9.727197 | 507 | 10.272803 | 10.054402 | 10.327205 | 55 |
| 6 | 9.673032 | 394 | 9.945531 | 112 | 9.727501 | 507 | 10.272499 | 10.054469 | 10.326968 | 54 |
| 7 | 9.673268 | 394 | 9.945464 | 113 | 9.727805 | 506 | 10.272195 | 10.054536 | 10.326732 | 53 |
| 8 | 9.673505 | 394 | 9.945396 | 113 | 9.728109 | 506 | 10.271891 | 10.054604 | 10.326495 | 52 |
| 9 | 9.673741 | 393 | 9.945328 | 113 | 9.728412 | 506 | 10.271588 | 10.054672 | 10.326259 | 51 |
| 10 | 9.673977 | 393 | 9.945261 | 113 | 9.728716 | 506 | 10.271284 | 10.054739 | 10.326023 | 50 |
| 11 | 9.674213 | 393 | 9.945193 | 113 | 9.729020 | 506 | 10.270980 | 10.054807 | 10.325787 | 49 |
| 12 | 9.674448 | 392 | 9.945125 | 113 | 9.729323 | 505 | 10.270677 | 10.054875 | 10.325552 | 48 |
| 13 | 9.674684 | 392 | 9.945058 | 113 | 9.729626 | 505 | 10.270374 | 10.054942 | 10.325316 | 47 |
| 14 | 9.674919 | 392 | 9.944990 | 113 | 9.729929 | 505 | 10.270071 | 10.055010 | 10.325081 | 46 |
| 15 | 9.675155 | 392 | 9.944922 | 113 | 9.730233 | 505 | 10.269767 | 10.055078 | 10.324845 | 45 |
| 16 | 9.675390 | 391 | 9.944854 | 113 | 9.730535 | 505 | 10.269465 | 10.055146 | 10.324610 | 44 |
| 17 | 9.675624 | 391 | 9.944786 | 113 | 9.730838 | 504 | 10.269162 | 10.055214 | 10.324376 | 43 |
| 18 | 9.675859 | 391 | 9.944718 | 113 | 9.731141 | 504 | 10.268859 | 10.055282 | 10.324141 | 42 |
| 19 | 9.676094 | 391 | 9.944650 | 113 | 9.731444 | 504 | 10.268556 | 10.055350 | 10.323906 | 41 |
| 20 | 9.676328 | 390 | 9.944582 | 113 | 9.731746 | 504 | 10.268254 | 10.055418 | 10.323672 | 40 |
| 21 | 9.676562 | 390 | 9.944514 | 114 | 9.732048 | 504 | 10.267952 | 10.055486 | 10.323438 | 39 |
| 22 | 9.676796 | 390 | 9.944446 | 114 | 9.732351 | 503 | 10.267649 | 10.055554 | 10.323204 | 38 |
| 23 | 9.677030 | 390 | 9.944377 | 114 | 9.732653 | 503 | 10.267347 | 10.055623 | 10.322970 | 37 |
| 24 | 9.677264 | 389 | 9.944309 | 114 | 9.732955 | 503 | 10.267045 | 10.055691 | 10.322736 | 36 |
| 25 | 9.677498 | 389 | 9.944241 | 114 | 9.733257 | 503 | 10.266743 | 10.055759 | 10.322502 | 35 |
| 26 | 9.677731 | 389 | 9.944172 | 114 | 9.733558 | 503 | 10.266442 | 10.055828 | 10.322269 | 34 |
| 27 | 9.677964 | 388 | 9.944104 | 114 | 9.733860 | 503 | 10.266140 | 10.055896 | 10.322036 | 33 |
| 28 | 9.678197 | 388 | 9.944036 | 114 | 9.734162 | 502 | 10.265838 | 10.055964 | 10.321803 | 32 |
| 29 | 9.678430 | 388 | 9.943967 | 114 | 9.734463 | 502 | 10.265537 | 10.056033 | 10.321570 | 31 |
| 30 | 9.678663 | 388 | 9.943899 | 114 | 9.734764 | 502 | 10.265236 | 10.056101 | 10.321337 | 30 |
| 31 | 9.678895 | 387 | 9.943830 | 114 | 9.735066 | 502 | 10.264934 | 10.056170 | 10.321105 | 29 |
| 32 | 9.679128 | 387 | 9.943761 | 114 | 9.735367 | 502 | 10.264633 | 10.056239 | 10.320872 | 28 |
| 33 | 9.679360 | 387 | 9.943693 | 115 | 9.735668 | 501 | 10.264332 | 10.056307 | 10.320640 | 27 |
| 34 | 9.679592 | 387 | 9.943624 | 115 | 9.735969 | 501 | 10.264031 | 10.056376 | 10.320408 | 26 |
| 35 | 9.679824 | 386 | 9.943555 | 115 | 9.736269 | 501 | 10.263731 | 10.056445 | 10.320176 | 25 |
| 36 | 9.680056 | 386 | 9.943486 | 115 | 9.736570 | 501 | 10.263430 | 10.056514 | 10.319944 | 24 |
| 37 | 9.680288 | 386 | 9.943417 | 115 | 9.736871 | 501 | 10.263129 | 10.056583 | 10.319712 | 23 |
| 38 | 9.680519 | 385 | 9.943348 | 115 | 9.737171 | 500 | 10.262829 | 10.056652 | 10.319481 | 22 |
| 39 | 9.680750 | 385 | 9.943279 | 115 | 9.737471 | 500 | 10.262529 | 10.056721 | 10.319250 | 21 |
| 40 | 9.680982 | 385 | 9.943210 | 115 | 9.737771 | 500 | 10.262229 | 10.056790 | 10.319018 | 20 |
| 41 | 9.681213 | 385 | 9.943141 | 115 | 9.738071 | 500 | 10.261929 | 10.056859 | 10.318787 | 19 |
| 42 | 9.681443 | 384 | 9.943072 | 115 | 9.738371 | 500 | 10.261629 | 10.056928 | 10.318557 | 18 |
| 43 | 9.681674 | 384 | 9.943003 | 115 | 9.738671 | 500 | 10.261329 | 10.056997 | 10.318326 | 17 |
| 44 | 9.681905 | 384 | 9.942934 | 115 | 9.738971 | 499 | 10.261029 | 10.057066 | 10.318095 | 16 |
| 45 | 9.682135 | 384 | 9.942864 | 115 | 9.739271 | 499 | 10.260729 | 10.057136 | 10.317865 | 15 |
| 46 | 9.682365 | 383 | 9.942795 | 116 | 9.739570 | 499 | 10.260430 | 10.057205 | 10.317635 | 14 |
| 47 | 9.682595 | 383 | 9.942726 | 116 | 9.739870 | 499 | 10.260130 | 10.057274 | 10.317405 | 13 |
| 48 | 9.682825 | 383 | 9.942656 | 116 | 9.740169 | 499 | 10.259831 | 10.057344 | 10.317175 | 12 |
| 49 | 9.683055 | 383 | 9.942587 | 116 | 9.740468 | 498 | 10.259532 | 10.057413 | 10.316945 | 11 |
| 50 | 9.683284 | 382 | 9.942517 | 116 | 9.740767 | 498 | 10.259233 | 10.057483 | 10.316716 | 10 |
| 51 | 9.683514 | 382 | 9.942448 | 116 | 9.741066 | 498 | 10.258934 | 10.057552 | 10.316486 | 9 |
| 52 | 9.683743 | 382 | 9.942378 | 116 | 9.741365 | 498 | 10.258635 | 10.057622 | 10.316257 | 8 |
| 53 | 9.683972 | 382 | 9.942308 | 116 | 9.741664 | 498 | 10.258336 | 10.057692 | 10.316028 | 7 |
| 54 | 9.684201 | 381 | 9.942239 | 116 | 9.741962 | 498 | 10.258038 | 10.057761 | 10.315799 | 6 |
| 55 | 9.684430 | 381 | 9.942169 | 116 | 9.742261 | 497 | 10.257739 | 10.057831 | 10.315570 | 5 |
| 56 | 9.684658 | 381 | 9.942099 | 116 | 9.742559 | 497 | 10.257441 | 10.057901 | 10.315342 | 4 |
| 57 | 9.684887 | 380 | 9.942029 | 116 | 9.742858 | 497 | 10.257142 | 10.057971 | 10.315113 | 3 |
| 58 | 9.685115 | 380 | 9.941959 | 116 | 9.743156 | 497 | 10.256844 | 10.058041 | 10.314885 | 2 |
| 59 | 9.685343 | 380 | 9.941889 | 117 | 9.743454 | 497 | 10.256546 | 10.058111 | 10.314657 | 1 |
| 60 | 9.685571 | | 9.941819 | | 9.743752 | | 10.256248 | 10.058181 | 10.314429 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

61 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 29 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.685571 | 380 | 9.941819 | 117 | 9.743752 | 496 | 10.256248 | 10.058181 | 10.314429 | 60 |
| 1 | 9.685799 | 379 | 9.941749 | 117 | 9.744050 | 496 | 10.255950 | 10.058251 | 10.314201 | 59 |
| 2 | 9.686027 | 379 | 9.941679 | 117 | 9.744348 | 496 | 10.255652 | 10.058321 | 10.313973 | 58 |
| 3 | 9.686254 | 379 | 9.941609 | 117 | 9.744645 | 496 | 10.255355 | 10.058391 | 10.313746 | 57 |
| 4 | 9.686482 | 379 | 9.941539 | 117 | 9.744943 | 496 | 10.255057 | 10.058461 | 10.313518 | 56 |
| 5 | 9.686709 | 378 | 9.941469 | 117 | 9.745240 | 496 | 10.254760 | 10.058531 | 10.313291 | 55 |
| 6 | 9.686936 | 378 | 9.941398 | 117 | 9.745538 | 495 | 10.254462 | 10.058602 | 10.313064 | 54 |
| 7 | 9.687163 | 378 | 9.941328 | 117 | 9.745835 | 496 | 10.254165 | 10.058672 | 10.312837 | 53 |
| 8 | 9.687389 | 378 | 9.941258 | 117 | 9.746132 | 495 | 10.253868 | 10.058742 | 10.312611 | 52 |
| 9 | 9.687616 | 377 | 9.941187 | 117 | 9.746429 | 495 | 10.253571 | 10.058813 | 10.312384 | 51 |
| 10 | 9.687843 | 377 | 9.941117 | 117 | 9.746726 | 496 | 10.253274 | 10.058883 | 10.312157 | 50 |
| 11 | 9.688069 | 377 | 9.941046 | 118 | 9.747023 | 494 | 10.252977 | 10.058954 | 10.311931 | 49 |
| 12 | 9.688295 | 377 | 9.940975 | 118 | 9.747319 | 494 | 10.252681 | 10.059025 | 10.311705 | 48 |
| 13 | 9.688521 | 376 | 9.940905 | 118 | 9.747616 | 494 | 10.252384 | 10.059095 | 10.311479 | 47 |
| 14 | 9.688747 | 376 | 9.940834 | 118 | 9.747913 | 494 | 10.252087 | 10.059166 | 10.311253 | 46 |
| 15 | 9.688972 | 376 | 9.940763 | 118 | 9.748209 | 494 | 10.251791 | 10.059237 | 10.311028 | 45 |
| 16 | 9.689198 | 376 | 9.940693 | 118 | 9.748505 | 494 | 10.251495 | 10.059307 | 10.310802 | 44 |
| 17 | 9.689423 | 375 | 9.940622 | 118 | 9.748801 | 493 | 10.251199 | 10.059378 | 10.310577 | 43 |
| 18 | 9.689648 | 375 | 9.940551 | 118 | 9.749097 | 493 | 10.250903 | 10.059449 | 10.310352 | 42 |
| 19 | 9.689873 | 375 | 9.940480 | 118 | 9.749393 | 493 | 10.250607 | 10.059520 | 10.310127 | 41 |
| 20 | 9.690098 | 375 | 9.940409 | 118 | 9.749689 | 493 | 10.250311 | 10.059591 | 10.309902 | 40 |
| 21 | 9.690323 | 374 | 9.940338 | 118 | 9.749985 | 493 | 10.250015 | 10.059662 | 10.309677 | 39 |
| 22 | 9.690548 | 374 | 9.940267 | 118 | 9.750281 | 493 | 10.249719 | 10.059733 | 10.309452 | 38 |
| 23 | 9.690772 | 374 | 9.940196 | 118 | 9.750576 | 492 | 10.249424 | 10.059804 | 10.309228 | 37 |
| 24 | 9.690996 | 374 | 9.940125 | 119 | 9.750872 | 492 | 10.249128 | 10.059875 | 10.309004 | 36 |
| 25 | 9.691220 | 373 | 9.940054 | 119 | 9.751167 | 492 | 10.248833 | 10.059946 | 10.308780 | 35 |
| 26 | 9.691444 | 373 | 9.939982 | 119 | 9.751462 | 492 | 10.248538 | 10.060018 | 10.308556 | 34 |
| 27 | 9.691668 | 373 | 9.939911 | 119 | 9.751757 | 492 | 10.248243 | 10.060089 | 10.308332 | 33 |
| 28 | 9.691892 | 373 | 9.939840 | 119 | 9.752052 | 491 | 10.247948 | 10.060160 | 10.308108 | 32 |
| 29 | 9.692115 | 372 | 9.939768 | 119 | 9.752347 | 491 | 10.247653 | 10.060232 | 10.307885 | 31 |
| 30 | 9.692339 | 372 | 9.939697 | 119 | 9.752642 | 491 | 10.247358 | 10.060303 | 10.307661 | 30 |
| 31 | 9.692562 | 372 | 9.939625 | 119 | 9.752937 | 491 | 10.247063 | 10.060375 | 10.307438 | 29 |
| 32 | 9.692785 | 371 | 9.939554 | 119 | 9.753231 | 491 | 10.246769 | 10.060446 | 10.307215 | 28 |
| 33 | 9.693008 | 371 | 9.939482 | 119 | 9.753526 | 491 | 10.246474 | 10.060518 | 10.306992 | 27 |
| 34 | 9.693231 | 371 | 9.939410 | 119 | 9.753820 | 490 | 10.246180 | 10.060590 | 10.306769 | 26 |
| 35 | 9.693453 | 371 | 9.939339 | 119 | 9.754115 | 490 | 10.245885 | 10.060661 | 10.306547 | 25 |
| 36 | 9.693676 | 370 | 9.939267 | 120 | 9.754409 | 490 | 10.245591 | 10.060733 | 10.306324 | 24 |
| 37 | 9.693898 | 370 | 9.939195 | 120 | 9.754703 | 490 | 10.245297 | 10.060805 | 10.306102 | 23 |
| 38 | 9.694120 | 370 | 9.939123 | 120 | 9.754997 | 490 | 10.245003 | 10.060877 | 10.305880 | 22 |
| 39 | 9.694342 | 370 | 9.939052 | 120 | 9.755291 | 490 | 10.244709 | 10.060948 | 10.305658 | 21 |
| 40 | 9.694564 | 369 | 9.938980 | 120 | 9.755585 | 489 | 10.244415 | 10.061020 | 10.305436 | 20 |
| 41 | 9.694786 | 369 | 9.938908 | 120 | 9.755878 | 489 | 10.244122 | 10.061092 | 10.305214 | 19 |
| 42 | 9.695007 | 369 | 9.938836 | 120 | 9.756172 | 489 | 10.243828 | 10.061164 | 10.304993 | 18 |
| 43 | 9.695229 | 369 | 9.938763 | 120 | 9.756465 | 489 | 10.243535 | 10.061237 | 10.304771 | 17 |
| 44 | 9.695450 | 368 | 9.938691 | 120 | 9.756759 | 489 | 10.243241 | 10.061309 | 10.304550 | 16 |
| 45 | 9.695671 | 368 | 9.938619 | 120 | 9.757052 | 489 | 10.242948 | 10.061381 | 10.304329 | 15 |
| 46 | 9.695892 | 368 | 9.938547 | 120 | 9.757345 | 488 | 10.242655 | 10.061453 | 10.304108 | 14 |
| 47 | 9.696113 | 368 | 9.938475 | 120 | 9.757638 | 488 | 10.242362 | 10.061525 | 10.303887 | 13 |
| 48 | 9.696334 | 367 | 9.938402 | 121 | 9.757931 | 488 | 10.242069 | 10.061598 | 10.303666 | 12 |
| 49 | 9.696554 | 367 | 9.938330 | 121 | 9.758224 | 488 | 10.241776 | 10.061670 | 10.303446 | 11 |
| 50 | 9.696775 | 367 | 9.938258 | 121 | 9.758517 | 488 | 10.241483 | 10.061742 | 10.303225 | 10 |
| 51 | 9.696995 | 367 | 9.938185 | 121 | 9.758810 | 488 | 10.241190 | 10.061815 | 10.303005 | 9 |
| 52 | 9.697215 | 366 | 9.938113 | 121 | 9.759102 | 487 | 10.240898 | 10.061887 | 10.302785 | 8 |
| 53 | 9.697435 | 366 | 9.938040 | 121 | 9.759395 | 487 | 10.240605 | 10.061960 | 10.302565 | 7 |
| 54 | 9.697654 | 366 | 9.937967 | 121 | 9.759687 | 487 | 10.240313 | 10.062033 | 10.302346 | 6 |
| 55 | 9.697874 | 366 | 9.937895 | 121 | 9.759979 | 487 | 10.240021 | 10.062105 | 10.302126 | 5 |
| 56 | 9.698094 | 365 | 9.937822 | 121 | 9.760272 | 487 | 10.239728 | 10.062178 | 10.301906 | 4 |
| 57 | 9.698313 | 365 | 9.937749 | 121 | 9.760564 | 487 | 10.239436 | 10.062251 | 10.301687 | 3 |
| 58 | 9.698532 | 365 | 9.937676 | 121 | 9.760856 | 486 | 10.239144 | 10.062324 | 10.301468 | 2 |
| 59 | 9.698751 | 365 | 9.937604 | 121 | 9.761148 | 486 | 10.238852 | 10.062396 | 10.301249 | 1 |
| 60 | 9.698970 | | 9.937531 | | 9.761439 | | 10.238561 | 10.062469 | 10.301030 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 30 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.698970 | 364 | 9.937531 | 121 | 9.761439 | 486 | 10.238561 | 10.062469 | 10.301030 | 60 |
| 1 | 9.699189 | 364 | 9.937458 | 122 | 9.761731 | 486 | 10.238269 | 10.062542 | 10.300811 | 59 |
| 2 | 9.699407 | 364 | 9.937385 | 122 | 9.762023 | 486 | 10.237977 | 10.062615 | 10.300593 | 58 |
| 3 | 9.699626 | 364 | 9.937312 | 122 | 9.762314 | 486 | 10.237686 | 10.062688 | 10.300374 | 57 |
| 4 | 9.699844 | 363 | 9.937238 | 122 | 9.762606 | 485 | 10.237394 | 10.062762 | 10.300156 | 56 |
| 5 | 9.700062 | 363 | 9.937165 | 122 | 9.762897 | 485 | 10.237103 | 10.062835 | 10.299938 | 55 |
| 6 | 9.700280 | 363 | 9.937092 | 122 | 9.763188 | 485 | 10.236812 | 10.062908 | 10.299720 | 54 |
| 7 | 9.700498 | 363 | 9.937019 | 122 | 9.763479 | 485 | 10.236521 | 10.062981 | 10.299502 | 53 |
| 8 | 9.700716 | 363 | 9.936946 | 122 | 9.763770 | 485 | 10.236230 | 10.063054 | 10.299284 | 52 |
| 9 | 9.700933 | 362 | 9.936872 | 122 | 9.764061 | 485 | 10.235939 | 10.063128 | 10.299067 | 51 |
| 10 | 9.701151 | 362 | 9.936799 | 122 | 9.764352 | 485 | 10.235648 | 10.063201 | 10.298849 | 50 |
| 11 | 9.701368 | 362 | 9.936725 | 122 | 9.764643 | 484 | 10.235357 | 10.063275 | 10.298632 | 49 |
| 12 | 9.701585 | 362 | 9.936652 | 123 | 9.764933 | 484 | 10.235067 | 10.063348 | 10.298415 | 48 |
| 13 | 9.701802 | 361 | 9.936578 | 123 | 9.765224 | 484 | 10.234776 | 10.063422 | 10.298198 | 47 |
| 14 | 9.702019 | 361 | 9.936505 | 123 | 9.765514 | 484 | 10.234486 | 10.063495 | 10.297981 | 46 |
| 15 | 9.702236 | 361 | 9.936431 | 123 | 9.765805 | 484 | 10.234195 | 10.063569 | 10.297764 | 45 |
| 16 | 9.702452 | 361 | 9.936357 | 123 | 9.766095 | 484 | 10.233905 | 10.063643 | 10.297548 | 44 |
| 17 | 9.702669 | 360 | 9.936284 | 123 | 9.766385 | 483 | 10.233615 | 10.063716 | 10.297331 | 43 |
| 18 | 9.702885 | 360 | 9.936210 | 123 | 9.766675 | 483 | 10.233325 | 10.063790 | 10.297115 | 42 |
| 19 | 9.703101 | 360 | 9.936136 | 123 | 9.766965 | 483 | 10.233035 | 10.063864 | 10.296899 | 41 |
| 20 | 9.703317 | 360 | 9.936062 | 123 | 9.767255 | 483 | 10.232745 | 10.063938 | 10.296683 | 40 |
| 21 | 9.703533 | 359 | 9.935988 | 123 | 9.767545 | 483 | 10.232455 | 10.064012 | 10.296467 | 39 |
| 22 | 9.703749 | 359 | 9.935914 | 123 | 9.767834 | 483 | 10.232166 | 10.064086 | 10.296251 | 38 |
| 23 | 9.703964 | 359 | 9.935840 | 123 | 9.768124 | 482 | 10.231876 | 10.064160 | 10.296036 | 37 |
| 24 | 9.704179 | 359 | 9.935766 | 124 | 9.768414 | 482 | 10.231586 | 10.064234 | 10.295821 | 36 |
| 25 | 9.704395 | 359 | 9.935692 | 124 | 9.768703 | 482 | 10.231297 | 10.064308 | 10.295605 | 35 |
| 26 | 9.704610 | 358 | 9.935618 | 124 | 9.768992 | 482 | 10.231008 | 10.064382 | 10.295390 | 34 |
| 27 | 9.704825 | 358 | 9.935543 | 124 | 9.769281 | 482 | 10.230719 | 10.064457 | 10.295175 | 33 |
| 28 | 9.705040 | 358 | 9.935469 | 124 | 9.769570 | 482 | 10.230430 | 10.064531 | 10.294960 | 32 |
| 29 | 9.705254 | 358 | 9.935395 | 124 | 9.769860 | 481 | 10.230140 | 10.064605 | 10.294746 | 31 |
| 30 | 9.705469 | 357 | 9.935320 | 124 | 9.770148 | 481 | 10.229852 | 10.064680 | 10.294531 | 30 |
| 31 | 9.705683 | 357 | 9.935246 | 124 | 9.770437 | 481 | 10.229563 | 10.064754 | 10.294317 | 29 |
| 32 | 9.705898 | 357 | 9.935171 | 124 | 9.770726 | 481 | 10.229274 | 10.064829 | 10.294102 | 28 |
| 33 | 9.706112 | 357 | 9.935097 | 124 | 9.771015 | 481 | 10.228985 | 10.064903 | 10.293888 | 27 |
| 34 | 9.706326 | 356 | 9.935022 | 124 | 9.771303 | 481 | 10.228697 | 10.064978 | 10.293674 | 26 |
| 35 | 9.706539 | 356 | 9.934948 | 124 | 9.771592 | 481 | 10.228408 | 10.065052 | 10.293461 | 25 |
| 36 | 9.706753 | 356 | 9.934873 | 124 | 9.771880 | 480 | 10.228120 | 10.065127 | 10.293247 | 24 |
| 37 | 9.706967 | 356 | 9.934798 | 125 | 9.772168 | 480 | 10.227832 | 10.065202 | 10.293033 | 23 |
| 38 | 9.707180 | 355 | 9.934723 | 125 | 9.772457 | 480 | 10.227543 | 10.065277 | 10.292820 | 22 |
| 39 | 9.707393 | 355 | 9.934649 | 125 | 9.772745 | 480 | 10.227255 | 10.065351 | 10.292607 | 21 |
| 40 | 9.707606 | 355 | 9.934574 | 125 | 9.773033 | 480 | 10.226967 | 10.065426 | 10.292394 | 20 |
| 41 | 9.707819 | 355 | 9.934499 | 125 | 9.773321 | 480 | 10.226679 | 10.065501 | 10.292181 | 19 |
| 42 | 9.708032 | 354 | 9.934424 | 125 | 9.773608 | 480 | 10.226392 | 10.065576 | 10.291968 | 18 |
| 43 | 9.708245 | 354 | 9.934349 | 125 | 9.773896 | 479 | 10.226104 | 10.065651 | 10.291755 | 17 |
| 44 | 9.708458 | 354 | 9.934274 | 125 | 9.774184 | 479 | 10.225816 | 10.065726 | 10.291542 | 16 |
| 45 | 9.708670 | 354 | 9.934199 | 125 | 9.774471 | 479 | 10.225529 | 10.065801 | 10.291330 | 15 |
| 46 | 9.708882 | 353 | 9.934123 | 125 | 9.774759 | 479 | 10.225241 | 10.065877 | 10.291118 | 14 |
| 47 | 9.709094 | 353 | 9.934048 | 125 | 9.775046 | 479 | 10.224954 | 10.065952 | 10.290906 | 13 |
| 48 | 9.709306 | 353 | 9.933973 | 125 | 9.775333 | 479 | 10.224667 | 10.066027 | 10.290694 | 12 |
| 49 | 9.709518 | 353 | 9.933898 | 125 | 9.775621 | 478 | 10.224379 | 10.066102 | 10.290482 | 11 |
| 50 | 9.709730 | 353 | 9.933822 | 126 | 9.775908 | 478 | 10.224092 | 10.066178 | 10.290270 | 10 |
| 51 | 9.709941 | 352 | 9.933747 | 126 | 9.776195 | 478 | 10.223805 | 10.066253 | 10.290059 | 9 |
| 52 | 9.710153 | 352 | 9.933671 | 126 | 9.776482 | 478 | 10.223518 | 10.066329 | 10.289847 | 8 |
| 53 | 9.710364 | 352 | 9.933596 | 126 | 9.776769 | 478 | 10.223231 | 10.066404 | 10.289636 | 7 |
| 54 | 9.710575 | 352 | 9.933520 | 126 | 9.777055 | 478 | 10.222945 | 10.066480 | 10.289425 | 6 |
| 55 | 9.710786 | 351 | 9.933445 | 126 | 9.777342 | 478 | 10.222658 | 10.066555 | 10.289214 | 5 |
| 56 | 9.710997 | 351 | 9.933369 | 126 | 9.777628 | 477 | 10.222372 | 10.066631 | 10.289003 | 4 |
| 57 | 9.711208 | 351 | 9.933293 | 126 | 9.777915 | 477 | 10.222085 | 10.066707 | 10.288792 | 3 |
| 58 | 9.711419 | 351 | 9.933217 | 126 | 9.778201 | 477 | 10.221799 | 10.066783 | 10.288581 | 2 |
| 59 | 9.711629 | 350 | 9.933141 | 126 | 9.778487 | 477 | 10.221513 | 10.066859 | 10.288371 | 1 |
| 60 | 9.711839 | 350 | 9.933066 | 126 | 9.778774 | 477 | 10.221226 | 10.066934 | 10.288161 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 59 Degrees.

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## 31 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.711839 | 350 | 9.933066 | 126 | 9.778774 | 477 | 10.221226 | 10.066934 | 10.288161 | 60 |
| 1 | 9.712050 | 350 | 9.932990 | 127 | 9.779060 | 477 | 10.220940 | 10.067010 | 10.287950 | 59 |
| 2 | 9.712260 | 350 | 9.932914 | 127 | 9.779346 | 477 | 10.220654 | 10.067086 | 10.287740 | 58 |
| 3 | 9.712469 | 349 | 9.932838 | 127 | 9.779632 | 476 | 10.220368 | 10.067162 | 10.287531 | 57 |
| 4 | 9.712679 | 349 | 9.932762 | 127 | 9.779918 | 476 | 10.220082 | 10.067238 | 10.287321 | 56 |
| 5 | 9.712889 | 349 | 9.932685 | 127 | 9.780203 | 476 | 10.219797 | 10.067315 | 10.287111 | 55 |
| 6 | 9.713098 | 349 | 9.932609 | 127 | 9.780489 | 476 | 10.219511 | 10.067391 | 10.286902 | 54 |
| 7 | 9.713308 | 349 | 9.932533 | 127 | 9.780775 | 476 | 10.219225 | 10.067467 | 10.286692 | 53 |
| 8 | 9.713517 | 348 | 9.932457 | 127 | 9.781060 | 476 | 10.218940 | 10.067543 | 10.286483 | 52 |
| 9 | 9.713726 | 348 | 9.932380 | 127 | 9.781346 | 476 | 10.218654 | 10.067620 | 10.286274 | 51 |
| 10 | 9.713935 | 348 | 9.932304 | 127 | 9.781631 | 475 | 10.218369 | 10.067696 | 10.286065 | 50 |
| 11 | 9.714144 | 348 | 9.932228 | 127 | 9.781916 | 475 | 10.218084 | 10.067772 | 10.285856 | 49 |
| 12 | 9.714352 | 347 | 9.932151 | 127 | 9.782201 | 475 | 10.217799 | 10.067849 | 10.285648 | 48 |
| 13 | 9.714561 | 347 | 9.932075 | 128 | 9.782486 | 475 | 10.217514 | 10.067925 | 10.285439 | 47 |
| 14 | 9.714769 | 347 | 9.931998 | 128 | 9.782771 | 475 | 10.217229 | 10.068002 | 10.285231 | 46 |
| 15 | 9.714978 | 347 | 9.931921 | 128 | 9.783056 | 475 | 10.216944 | 10.068079 | 10.285022 | 45 |
| 16 | 9.715186 | 347 | 9.931845 | 128 | 9.783341 | 475 | 10.216659 | 10.068155 | 10.284814 | 44 |
| 17 | 9.715394 | 346 | 9.931768 | 128 | 9.783626 | 474 | 10.216374 | 10.068232 | 10.284606 | 43 |
| 18 | 9.715602 | 346 | 9.931691 | 128 | 9.783910 | 474 | 10.216090 | 10.068309 | 10.284398 | 42 |
| 19 | 9.715809 | 346 | 9.931614 | 128 | 9.784195 | 474 | 10.215805 | 10.068386 | 10.284191 | 41 |
| 20 | 9.716017 | 346 | 9.931537 | 128 | 9.784479 | 474 | 10.215521 | 10.068463 | 10.283983 | 40 |
| 21 | 9.716224 | 345 | 9.931460 | 128 | 9.784764 | 474 | 10.215236 | 10.068540 | 10.283776 | 39 |
| 22 | 9.716432 | 345 | 9.931383 | 128 | 9.785048 | 474 | 10.214952 | 10.068617 | 10.283568 | 38 |
| 23 | 9.716639 | 345 | 9.931306 | 128 | 9.785332 | 474 | 10.214668 | 10.068694 | 10.283361 | 37 |
| 24 | 9.716846 | 345 | 9.931229 | 129 | 9.785616 | 473 | 10.214384 | 10.068771 | 10.283154 | 36 |
| 25 | 9.717053 | 345 | 9.931152 | 129 | 9.785900 | 473 | 10.214100 | 10.068848 | 10.282947 | 35 |
| 26 | 9.717259 | 344 | 9.931075 | 129 | 9.786184 | 473 | 10.213816 | 10.068925 | 10.282741 | 34 |
| 27 | 9.717466 | 344 | 9.930998 | 129 | 9.786468 | 473 | 10.213532 | 10.069002 | 10.282534 | 33 |
| 28 | 9.717673 | 344 | 9.930921 | 129 | 9.786752 | 473 | 10.213248 | 10.069079 | 10.282327 | 32 |
| 29 | 9.717879 | 344 | 9.930843 | 129 | 9.787036 | 473 | 10.212964 | 10.069157 | 10.282121 | 31 |
| 30 | 9.718085 | 343 | 9.930766 | 129 | 9.787319 | 473 | 10.212681 | 10.069234 | 10.281915 | 30 |
| 31 | 9.718291 | 343 | 9.930688 | 129 | 9.787603 | 472 | 10.212397 | 10.069312 | 10.281709 | 29 |
| 32 | 9.718497 | 343 | 9.930611 | 129 | 9.787886 | 472 | 10.212114 | 10.069389 | 10.281503 | 28 |
| 33 | 9.718703 | 343 | 9.930533 | 129 | 9.788170 | 472 | 10.211830 | 10.069467 | 10.281297 | 27 |
| 34 | 9.718909 | 343 | 9.930456 | 129 | 9.788453 | 472 | 10.211547 | 10.069544 | 10.281091 | 26 |
| 35 | 9.719114 | 342 | 9.930378 | 129 | 9.788736 | 472 | 10.211264 | 10.069622 | 10.280886 | 25 |
| 36 | 9.719320 | 342 | 9.930300 | 130 | 9.789019 | 472 | 10.210981 | 10.069700 | 10.280680 | 24 |
| 37 | 9.719525 | 342 | 9.930223 | 130 | 9.789302 | 472 | 10.210698 | 10.069777 | 10.280475 | 23 |
| 38 | 9.719730 | 342 | 9.930145 | 130 | 9.789585 | 471 | 10.210415 | 10.069855 | 10.280270 | 22 |
| 39 | 9.719935 | 341 | 9.930067 | 130 | 9.789868 | 471 | 10.210132 | 10.069933 | 10.280065 | 21 |
| 40 | 9.720140 | 341 | 9.929989 | 130 | 9.790151 | 471 | 10.209849 | 10.070011 | 10.279860 | 20 |
| 41 | 9.720345 | 341 | 9.929911 | 130 | 9.790433 | 471 | 10.209567 | 10.070089 | 10.279655 | 19 |
| 42 | 9.720549 | 341 | 9.929833 | 130 | 9.790716 | 471 | 10.209284 | 10.070167 | 10.279451 | 18 |
| 43 | 9.720754 | 340 | 9.929755 | 130 | 9.790999 | 471 | 10.209001 | 10.070245 | 10.279246 | 17 |
| 44 | 9.720958 | 340 | 9.929677 | 130 | 9.791281 | 471 | 10.208719 | 10.070323 | 10.279042 | 16 |
| 45 | 9.721162 | 340 | 9.929599 | 130 | 9.791563 | 470 | 10.208437 | 10.070401 | 10.278838 | 15 |
| 46 | 9.721366 | 340 | 9.929521 | 130 | 9.791846 | 470 | 10.208154 | 10.070479 | 10.278634 | 14 |
| 47 | 9.721570 | 340 | 9.929442 | 130 | 9.792128 | 470 | 10.207872 | 10.070558 | 10.278430 | 13 |
| 48 | 9.721774 | 339 | 9.929364 | 131 | 9.792410 | 470 | 10.207590 | 10.070636 | 10.278226 | 12 |
| 49 | 9.721978 | 339 | 9.929286 | 131 | 9.792692 | 470 | 10.207308 | 10.070714 | 10.278022 | 11 |
| 50 | 9.722181 | 339 | 9.929207 | 131 | 9.792974 | 470 | 10.207026 | 10.070793 | 10.277819 | 10 |
| 51 | 9.722385 | 339 | 9.929129 | 131 | 9.793256 | 470 | 10.206744 | 10.070671 | 10.277615 | 9 |
| 52 | 9.722588 | 339 | 9.929050 | 131 | 9.793538 | 469 | 10.206462 | 10.070950 | 10.277412 | 8 |
| 53 | 9.722791 | 338 | 9.928972 | 131 | 9.793819 | 469 | 10.206181 | 10.071028 | 10.277209 | 7 |
| 54 | 9.722994 | 338 | 9.928893 | 131 | 9.794101 | 469 | 10.205899 | 10.071107 | 10.277006 | 6 |
| 55 | 9.723197 | 338 | 9.928815 | 131 | 9.794383 | 469 | 10.205617 | 10.071185 | 10.276803 | 5 |
| 56 | 9.723400 | 338 | 9.928736 | 131 | 9.794664 | 469 | 10.205336 | 10.071264 | 10.276600 | 4 |
| 57 | 9.723603 | 337 | 9.928657 | 131 | 9.794945 | 469 | 10.205055 | 10.071343 | 10.276397 | 3 |
| 58 | 9.723805 | 337 | 9.928578 | 131 | 9.795227 | 469 | 10.204773 | 10.071422 | 10.276195 | 2 |
| 59 | 9.724007 | 337 | 9.928499 | 131 | 9.795508 | 468 | 10.204492 | 10.071501 | 10.275993 | 1 |
| 60 | 9.724210 | | 9.928420 | | 9.795789 | | 10.204211 | 10.071580 | 10.275790 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 58 Degrees.

32 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.724210 | 337 | 9.928420 | 132 | 9.795789 | 468 | 10.204211 | 10.071580 | 10.275790 | 60 |
| 1 | 9.724412 | 337 | 9.928342 | 132 | 9.796070 | 468 | 10.203930 | 10.071658 | 10.275588 | 59 |
| 2 | 9.724614 | 336 | 9.928263 | 132 | 9.796351 | 468 | 10.203649 | 10.071737 | 10.275386 | 58 |
| 3 | 9.724816 | 336 | 9.928183 | 132 | 9.796632 | 468 | 10.203368 | 10.071817 | 10.275184 | 57 |
| 4 | 9.725017 | 336 | 9.928104 | 132 | 9.796913 | 468 | 10.203087 | 10.071896 | 10.274983 | 56 |
| 5 | 9.725219 | 336 | 9.928025 | 132 | 9.797194 | 468 | 10.202806 | 10.071975 | 10.274781 | 55 |
| 6 | 9.725420 | 335 | 9.927946 | 132 | 9.797475 | 468 | 10.202525 | 10.072054 | 10.274580 | 54 |
| 7 | 9.725622 | 335 | 9.927867 | 132 | 9.797755 | 467 | 10.202245 | 10.072133 | 10.274378 | 53 |
| 8 | 9.725823 | 335 | 9.927787 | 132 | 9.798036 | 467 | 10.201964 | 10.072213 | 10.274177 | 52 |
| 9 | 9.726024 | 335 | 9.927708 | 132 | 9.798316 | 467 | 10.201684 | 10.072292 | 10.273976 | 51 |
| 10 | 9.726225 | 335 | 9.927629 | 132 | 9.798596 | 467 | 10.201404 | 10.072371 | 10.273775 | 50 |
| 11 | 9.726426 | 334 | 9.927549 | 132 | 9.798877 | 467 | 10.201123 | 10.072451 | 10.273574 | 49 |
| 12 | 9.726626 | 334 | 9.927470 | 133 | 9.799157 | 467 | 10.200843 | 10.072530 | 10.273374 | 48 |
| 13 | 9.726827 | 334 | 9.927390 | 133 | 9.799437 | 467 | 10.200563 | 10.072610 | 10.273173 | 47 |
| 14 | 9.727027 | 334 | 9.927310 | 133 | 9.799717 | 467 | 10.200283 | 10.072690 | 10.272973 | 46 |
| 15 | 9.727228 | 334 | 9.927231 | 133 | 9.799997 | 466 | 10.200003 | 10.072769 | 10.272772 | 45 |
| 16 | 9.727428 | 333 | 9.927151 | 133 | 9.800277 | 466 | 10.199723 | 10.072849 | 10.272572 | 44 |
| 17 | 9.727628 | 333 | 9.927071 | 133 | 9.800557 | 466 | 10.199443 | 10.072929 | 10.272372 | 43 |
| 18 | 9.727828 | 333 | 9.926991 | 133 | 9.800836 | 466 | 10.199164 | 10.073009 | 10.272172 | 42 |
| 19 | 9.728027 | 333 | 9.926911 | 133 | 9.801116 | 466 | 10.198884 | 10.073089 | 10.271973 | 41 |
| 20 | 9.728227 | 333 | 9.926831 | 133 | 9.801396 | 466 | 10.198604 | 10.073169 | 10.271773 | 40 |
| 21 | 9.728427 | 332 | 9.926751 | 133 | 9.801675 | 466 | 10.198325 | 10.073249 | 10.271573 | 39 |
| 22 | 9.728626 | 332 | 9.926671 | 133 | 9.801955 | 466 | 10 198045 | 10.073329 | 10.271374 | 38 |
| 23 | 9.728825 | 332 | 9.926591 | 133 | 9.802234 | 465 | 10 197766 | 10.073409 | 10.271175 | 37 |
| 24 | 9.729024 | 332 | 9.926511 | 134 | 9.802513 | 465 | 10.197487 | 10.073489 | 10.270976 | 36 |
| 25 | 9.729223 | 331 | 9.926431 | 134 | 9.802792 | 465 | 10.197208 | 10.073569 | 10.270777 | 35 |
| 26 | 9.729422 | 331 | 9.926351 | 134 | 9.803072 | 465 | 10.196928 | 10.073649 | 10.270578 | 34 |
| 27 | 9.729621 | 331 | 9.926270 | 134 | 9.803351 | 465 | 10.196649 | 10.073730 | 10.270379 | 33 |
| 28 | 9.729820 | 331 | 9.926190 | 134 | 9.803630 | 465 | 10.196370 | 10.073810 | 10.270180 | 32 |
| 29 | 9.730018 | 330 | 9.926110 | 134 | 9.803908 | 465 | 10.196092 | 10.073890 | 10.269982 | 31 |
| 30 | 9.730217 | 330 | 9.926029 | 134 | 9.804187 | 465 | 10.195813 | 10.073971 | 10.269783 | 30 |
| 31 | 9.730415 | 330 | 9.925949 | 134 | 9.804466 | 464 | 10.195534 | 10.074051 | 10.269585 | 29 |
| 32 | 9.730613 | 330 | 9.925868 | 134 | 9.804745 | 464 | 10.195255 | 10.074132 | 10.269387 | 28 |
| 33 | 9.730811 | 330 | 9.925788 | 134 | 9.805023 | 464 | 10.194977 | 10.074212 | 10.269189 | 27 |
| 34 | 9.731009 | 329 | 9.925707 | 134 | 9.805302 | 464 | 10.194698 | 10.074293 | 10.268991 | 26 |
| 35 | 9.731206 | 329 | 9.925626 | 134 | 9.805580 | 464 | 10.194420 | 10.074374 | 10.268794 | 25 |
| 36 | 9.731404 | 329 | 9.925545 | 135 | 9.805859 | 464 | 10.194141 | 10.074455 | 10.268596 | 24 |
| 37 | 9.731602 | 329 | 9.925465 | 135 | 9.806137 | 464 | 10.193863 | 10.074535 | 10.268398 | 23 |
| 38 | 9.731799 | 329 | 9.925384 | 135 | 9.806415 | 464 | 10.193585 | 10.074616 | 10.268201 | 22 |
| 39 | 9.731996 | 328 | 9.925303 | 135 | 9.806693 | 463 | 10.193307 | 10.074697 | 10.268004 | 21 |
| 40 | 9.732193 | 328 | 9.925222 | 135 | 9.806971 | 463 | 10.193029 | 10.074778 | 10.267807 | 20 |
| 41 | 9.732390 | 328 | 9.925141 | 135 | 9.807249 | 463 | 10.192751 | 10.074859 | 10.267610 | 19 |
| 42 | 9.732587 | 328 | 9.925060 | 135 | 9.807527 | 463 | 10.192473 | 10.074940 | 10.267413 | 18 |
| 43 | 9.732784 | 328 | 9.924979 | 135 | 9.807805 | 463 | 10.192195 | 10.075021 | 10.267216 | 17 |
| 44 | 9.732980 | 327 | 9.924897 | 135 | 9.808083 | 463 | 10.191917 | 10.075103 | 10.267020 | 16 |
| 45 | 9.733177 | 327 | 9.924816 | 135 | 9.808361 | 463 | 10.191639 | 10.075184 | 10.266823 | 15 |
| 46 | 9.733373 | 327 | 9.924735 | 136 | 9.808638 | 463 | 10.191362 | 10.075265 | 10.266627 | 14 |
| 47 | 9.733569 | 327 | 9.924654 | 136 | 9.808916 | 462 | 10.191084 | 10.075346 | 10.266431 | 13 |
| 48 | 9.733765 | 327 | 9.924572 | 136 | 9.809193 | 462 | 10.190807 | 10.075428 | 10.266235 | 12 |
| 49 | 9.733961 | 326 | 9.924491 | 136 | 9.809471 | 462 | 10.190529 | 10.075509 | 10.266039 | 11 |
| 50 | 9.734157 | 326 | 9.924409 | 136 | 9.809748 | 462 | 10.190252 | 10.075591 | 10.265843 | 10 |
| 51 | 9.734353 | 326 | 9.924328 | 136 | 9.810025 | 462 | 10.189975 | 10.075672 | 10.265647 | 9 |
| 52 | 9.734549 | 326 | 9.924246 | 136 | 9.810302 | 462 | 10.189698 | 10.075754 | 10.265451 | 8 |
| 53 | 9.734744 | 325 | 9.924164 | 136 | 9.810580 | 462 | 10.189420 | 10.075836 | 10.265256 | 7 |
| 54 | 9.734939 | 325 | 9.924083 | 136 | 9.810857 | 462 | 10.189143 | 10.075917 | 10.265061 | 6 |
| 55 | 9.735135 | 325 | 9.924001 | 136 | 9.811134 | 461 | 10.188866 | 10.075999 | 10.264865 | 5 |
| 56 | 9.735330 | 325 | 9.923919 | 136 | 9.811410 | 461 | 10.188590 | 10.076081 | 10.264670 | 4 |
| 57 | 9.735525 | 325 | 9.923837 | 136 | 9.811687 | 461 | 10.188313 | 10.076163 | 10.264475 | 3 |
| 58 | 9.735719 | 324 | 9.923755 | 137 | 9.811964 | 461 | 10.188036 | 10.076245 | 10.264281 | 2 |
| 59 | 9.735914 | 324 | 9.923673 | 137 | 9.812241 | 461 | 10.187759 | 10.076327 | 10.264086 | 1 |
| 60 | 9.736109 | | 9.923591 | | 9.812517 | | 10.187483 | 10.076409 | 10.263891 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

57 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 33 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.736109 | 324 | 9.923591 | 137 | 9.812517 | 461 | 10.187483 | 10.076409 | 10.263891 | 60 |
| 1 | 9.736303 | 324 | 9.923509 | 137 | 9.812794 | 461 | 10.187206 | 10.076491 | 10.263697 | 59 |
| 2 | 9.736498 | 324 | 9.923427 | 137 | 9.813070 | 461 | 10.186930 | 10.076573 | 10.263502 | 58 |
| 3 | 9.736692 | 323 | 9.923345 | 137 | 9.813347 | 460 | 10.186653 | 10.076655 | 10.263308 | 57 |
| 4 | 9.736886 | 323 | 9.923263 | 137 | 9.813623 | 460 | 10.186377 | 10.076737 | 10.263114 | 56 |
| 5 | 9.737080 | 323 | 9.923181 | 137 | 9.813899 | 460 | 10.186101 | 10.076819 | 10.262920 | 55 |
| 6 | 9.737274 | 323 | 9.923098 | 137 | 9.814175 | 460 | 10.185825 | 10.076902 | 10.262726 | 54 |
| 7 | 9.737467 | 323 | 9.923016 | 137 | 9.814452 | 460 | 10.185548 | 10.076984 | 10.262533 | 53 |
| 8 | 9.737661 | 322 | 9.922933 | 137 | 9.814728 | 460 | 10.185272 | 10.077067 | 10.262339 | 52 |
| 9 | 9.737855 | 322 | 9.922851 | 137 | 9.815004 | 460 | 10.184996 | 10.077149 | 10.262145 | 51 |
| 10 | 9.738048 | 322 | 9.922768 | 138 | 9.815279 | 460 | 10.184721 | 10.077232 | 10.261952 | 50 |
| 11 | 9.738241 | 322 | 9.922686 | 138 | 9.815555 | 460 | 10.184445 | 10.077314 | 10.261759 | 49 |
| 12 | 9.738434 | 322 | 9.922603 | 138 | 9.815831 | 459 | 10.184169 | 10.077397 | 10.261566 | 48 |
| 13 | 9.738627 | 321 | 9.922520 | 138 | 9.816107 | 459 | 10.183893 | 10.077480 | 10.261373 | 47 |
| 14 | 9.738820 | 321 | 9.922438 | 138 | 9.816382 | 459 | 10.183618 | 10.077562 | 10.261180 | 46 |
| 15 | 9.739013 | 321 | 9.922355 | 138 | 9.816658 | 459 | 10.183342 | 10.077645 | 10.260987 | 45 |
| 16 | 9.739206 | 321 | 9.922272 | 138 | 9.816933 | 459 | 10.183067 | 10.077728 | 10.260794 | 44 |
| 17 | 9.739398 | 321 | 9.922189 | 138 | 9.817209 | 459 | 10.182791 | 10.077811 | 10.260602 | 43 |
| 18 | 9.739590 | 320 | 9.922106 | 138 | 9.817484 | 459 | 10.182516 | 10.077894 | 10.260410 | 42 |
| 19 | 9.739783 | 320 | 9.922023 | 138 | 9.817759 | 459 | 10.182241 | 10.077977 | 10.260217 | 41 |
| 20 | 9.739975 | 320 | 9.921940 | 138 | 9.818035 | 459 | 10.181965 | 10.078060 | 10.260025 | 40 |
| 21 | 9.740167 | 320 | 9.921857 | 139 | 9.818310 | 458 | 10.181690 | 10.078143 | 10.259833 | 39 |
| 22 | 9.740359 | 320 | 9.921774 | 139 | 9.818585 | 458 | 10.181415 | 10.078226 | 10.259641 | 38 |
| 23 | 9.740550 | 319 | 9.921691 | 139 | 9.818860 | 458 | 10.181140 | 10.078309 | 10.259450 | 37 |
| 24 | 9.740742 | 319 | 9.921607 | 139 | 9.819135 | 458 | 10.180865 | 10.078393 | 10.259258 | 36 |
| 25 | 9.740934 | 319 | 9.921524 | 139 | 9.819410 | 458 | 10.180590 | 10.078476 | 10.259066 | 35 |
| 26 | 9.741125 | 319 | 9.921441 | 139 | 9.819684 | 458 | 10.180316 | 10.078559 | 10.258875 | 34 |
| 27 | 9.741316 | 319 | 9.921357 | 139 | 9.819959 | 458 | 10.180041 | 10.078643 | 10.258684 | 33 |
| 28 | 9.741508 | 318 | 9.921274 | 139 | 9.820234 | 458 | 10.179766 | 10.078726 | 10.258492 | 32 |
| 29 | 9.741699 | 318 | 9.921190 | 139 | 9.820508 | 458 | 10.179492 | 10.078810 | 10.258301 | 31 |
| 30 | 9.741889 | 318 | 9.921107 | 139 | 9.820783 | 457 | 10.179217 | 10.078893 | 10.258111 | 30 |
| 31 | 9.742080 | 318 | 9.921023 | 139 | 9.821057 | 457 | 10.178943 | 10.078977 | 10.257920 | 29 |
| 32 | 9.742271 | 318 | 9.920939 | 139 | 9.821332 | 457 | 10.178668 | 10.079061 | 10.257729 | 28 |
| 33 | 9.742462 | 317 | 9.920856 | 140 | 9.821606 | 457 | 10.178394 | 10.079144 | 10.257538 | 27 |
| 34 | 9.742652 | 317 | 9.920772 | 140 | 9.821880 | 457 | 10.178120 | 10.079228 | 10.257348 | 26 |
| 35 | 9.742842 | 317 | 9.920688 | 140 | 9.822154 | 457 | 10.177846 | 10.079312 | 10.257158 | 25 |
| 36 | 9.743033 | 317 | 9.920604 | 140 | 9.822429 | 457 | 10.177571 | 10.079396 | 10.256967 | 24 |
| 37 | 9.743223 | 317 | 9.920520 | 140 | 9.822703 | 457 | 10.177297 | 10.079480 | 10.256777 | 23 |
| 38 | 9.743413 | 316 | 9.920436 | 140 | 9.822977 | 457 | 10.177023 | 10.079564 | 10.256587 | 22 |
| 39 | 9.743602 | 316 | 9.920352 | 140 | 9.823250 | 456 | 10.176750 | 10.079648 | 10.256398 | 21 |
| 40 | 9.743792 | 316 | 9.920268 | 140 | 9.823524 | 456 | 10.176476 | 10.079732 | 10.256208 | 20 |
| 41 | 9.743982 | 316 | 9.920184 | 140 | 9.823798 | 456 | 10.176202 | 10.079816 | 10.256018 | 19 |
| 42 | 9.744171 | 316 | 9.920099 | 140 | 9.824072 | 456 | 10.175928 | 10.079901 | 10.255829 | 18 |
| 43 | 9.744361 | 315 | 9.920015 | 140 | 9.824345 | 456 | 10.175655 | 10.079985 | 10.255639 | 17 |
| 44 | 9.744550 | 315 | 9.919931 | 141 | 9.824619 | 456 | 10.175381 | 10.080069 | 10.255450 | 16 |
| 45 | 9.744739 | 315 | 9.919846 | 141 | 9.824893 | 456 | 10.175107 | 10.080154 | 10.255261 | 15 |
| 46 | 9.744928 | 315 | 9.919762 | 141 | 9.825166 | 456 | 10.174834 | 10.080238 | 10.255072 | 14 |
| 47 | 9.745117 | 315 | 9.919677 | 141 | 9.825439 | 456 | 10.174561 | 10.080323 | 10.254883 | 13 |
| 48 | 9.745306 | 314 | 9.919593 | 141 | 9.825713 | 455 | 10.174287 | 10.080407 | 10.254694 | 12 |
| 49 | 9.745494 | 314 | 9.919508 | 141 | 9.825986 | 455 | 10.174014 | 10.080492 | 10.254506 | 11 |
| 50 | 9.745683 | 314 | 9.919424 | 141 | 9.826259 | 455 | 10.173741 | 10.080576 | 10.254317 | 10 |
| 51 | 9.745871 | 314 | 9.919339 | 141 | 9.826532 | 455 | 10.173468 | 10.080661 | 10.254129 | 9 |
| 52 | 9.746060 | 314 | 9.919254 | 141 | 9.826805 | 455 | 10.173195 | 10.080746 | 10.253940 | 8 |
| 53 | 9.746248 | 313 | 9.919169 | 141 | 9.827078 | 455 | 10.172922 | 10.080831 | 10.253752 | 7 |
| 54 | 9.746436 | 313 | 9.919085 | 141 | 9.827351 | 455 | 10.172649 | 10.080915 | 10.253564 | 6 |
| 55 | 9.746624 | 313 | 9.919000 | 142 | 9.827624 | 455 | 10.172376 | 10.081000 | 10.253376 | 5 |
| 56 | 9.746812 | 313 | 9.918915 | 142 | 9.827897 | 455 | 10.172103 | 10.081085 | 10.253188 | 4 |
| 57 | 9.746999 | 313 | 9.918830 | 142 | 9.828170 | 454 | 10.171830 | 10.081170 | 10.253001 | 3 |
| 58 | 9.747187 | 312 | 9.918745 | 142 | 9.828442 | 454 | 10.171558 | 10.081255 | 10.252813 | 2 |
| 59 | 9.747374 | 312 | 9.918659 | 142 | 9.828715 | 454 | 10.171285 | 10.081341 | 10.252626 | 1 |
| 60 | 9.747562 | | 9.918574 | | 9.828987 | | 10.171013 | 10.081426 | 10.252438 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 34 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.747562 | 312 | 9.918574 | 142 | 9.828967 | 454 | 10.171013 | 10.081426 | 10.252438 | 60 |
| 1 | 9.747749 | 312 | 9.918489 | 142 | 9.829260 | 454 | 10.170740 | 10.081511 | 10.252251 | 59 |
| 2 | 9.747936 | 312 | 9.918404 | 142 | 9.829532 | 454 | 10.170468 | 10.081596 | 10.252064 | 58 |
| 3 | 9.748123 | 311 | 9.918318 | 142 | 9.829805 | 454 | 10.170195 | 10.081682 | 10.251877 | 57 |
| 4 | 9.748310 | 311 | 9.918233 | 142 | 9.830077 | 454 | 10.169923 | 10.081767 | 10.251690 | 56 |
| 5 | 9.748497 | 311 | 9.918147 | 142 | 9.830349 | 454 | 10.169651 | 10.081853 | 10.251503 | 55 |
| 6 | 9.748683 | 311 | 9.918062 | 143 | 9.830621 | 453 | 10.169379 | 10.081938 | 10.251317 | 54 |
| 7 | 9.748870 | 311 | 9.917976 | 143 | 9.830893 | 453 | 10.169107 | 10.082024 | 10.251130 | 53 |
| 8 | 9.749056 | 310 | 9.917891 | 143 | 9.831165 | 453 | 10.168835 | 10.082109 | 10.250944 | 52 |
| 9 | 9.749243 | 310 | 9.917805 | 143 | 9.831437 | 453 | 10.168563 | 10.082195 | 10.250757 | 51 |
| 10 | 9.749429 | 310 | 9.917719 | 143 | 9.831709 | 453 | 10.168291 | 10.082281 | 10.250571 | 50 |
| 11 | 9.749615 | 310 | 9.917634 | 143 | 9.831981 | 453 | 10.168019 | 10.082366 | 10.250385 | 49 |
| 12 | 9.749801 | 310 | 9.917548 | 143 | 9.832253 | 453 | 10.167747 | 10.082452 | 10.250199 | 48 |
| 13 | 9.749987 | 309 | 9.917462 | 143 | 9.832525 | 453 | 10.167475 | 10.082538 | 10.250013 | 47 |
| 14 | 9.750172 | 309 | 9.917376 | 143 | 9.832796 | 453 | 10.167204 | 10.082624 | 10.249828 | 46 |
| 15 | 9.750358 | 309 | 9.917290 | 143 | 9.833068 | 453 | 10.166932 | 10.082710 | 10.249642 | 45 |
| 16 | 9.750543 | 309 | 9.917204 | 143 | 9.833339 | 452 | 10.166661 | 10.082796 | 10.249457 | 44 |
| 17 | 9.750729 | 309 | 9.917118 | 144 | 9.833611 | 452 | 10.166389 | 10.082882 | 10.249271 | 43 |
| 18 | 9.750914 | 308 | 9.917032 | 144 | 9.833882 | 452 | 10.166118 | 10.082968 | 10.249086 | 42 |
| 19 | 9.751099 | 308 | 9.916946 | 144 | 9.834154 | 452 | 10.165846 | 10.083054 | 10.248901 | 41 |
| 20 | 9.751284 | 308 | 9.916859 | 144 | 9.834425 | 452 | 10.165575 | 10.083141 | 10.248716 | 40 |
| 21 | 9.751469 | 308 | 9.916773 | 144 | 9.834696 | 452 | 10.165304 | 10.083227 | 10.248531 | 39 |
| 22 | 9.751654 | 308 | 9.916687 | 144 | 9.834967 | 452 | 10.165033 | 10.083313 | 10.248346 | 38 |
| 23 | 9.751839 | 308 | 9.916600 | 144 | 9.835238 | 452 | 10.164762 | 10.083400 | 10.248161 | 37 |
| 24 | 9.752023 | 307 | 9.916514 | 144 | 9.835509 | 452 | 10.164491 | 10.083486 | 10.247977 | 36 |
| 25 | 9.752208 | 307 | 9.916427 | 144 | 9.835780 | 452 | 10.164220 | 10.083573 | 10.247792 | 35 |
| 26 | 9.752392 | 307 | 9.916341 | 144 | 9.836051 | 451 | 10.163949 | 10.083659 | 10.247608 | 34 |
| 27 | 9.752576 | 307 | 9.916254 | 144 | 9.836322 | 451 | 10.163678 | 10.083746 | 10.247424 | 33 |
| 28 | 9.752760 | 307 | 9.916167 | 145 | 9.836593 | 451 | 10.163407 | 10.083833 | 10.247240 | 32 |
| 29 | 9.752944 | 306 | 9.916081 | 145 | 9.836864 | 451 | 10.163136 | 10.083919 | 10.247056 | 31 |
| 30 | 9.753128 | 306 | 9.915994 | 145 | 9.837134 | 451 | 10.162866 | 10.084006 | 10.246872 | 30 |
| 31 | 9.753312 | 306 | 9.915907 | 145 | 9.837405 | 451 | 10.162595 | 10.084093 | 10.246688 | 29 |
| 32 | 9.753495 | 306 | 9.915820 | 145 | 9.837675 | 451 | 10.162325 | 10.084180 | 10.246505 | 28 |
| 33 | 9.753679 | 306 | 9.915733 | 145 | 9.837946 | 451 | 10.162054 | 10.084267 | 10.246321 | 27 |
| 34 | 9.753862 | 305 | 9.915646 | 145 | 9.838216 | 451 | 10.161784 | 10.084354 | 10.246138 | 26 |
| 35 | 9.754046 | 305 | 9.915559 | 145 | 9.838487 | 451 | 10.161513 | 10.084441 | 10.245954 | 25 |
| 36 | 9.754229 | 305 | 9.915472 | 145 | 9.838757 | 450 | 10.161243 | 10.084528 | 10.245771 | 24 |
| 37 | 9.754412 | 305 | 9.915385 | 145 | 9.839027 | 450 | 10.160973 | 10.084615 | 10.245588 | 23 |
| 38 | 9.754595 | 305 | 9.915297 | 145 | 9.839297 | 450 | 10.160703 | 10.084703 | 10.245405 | 22 |
| 39 | 9.754778 | 305 | 9.915210 | 145 | 9.839568 | 450 | 10.160432 | 10.084790 | 10.245222 | 21 |
| 40 | 9.754960 | 304 | 9.915123 | 145 | 9.839838 | 450 | 10.160162 | 10.084877 | 10.245040 | 20 |
| 41 | 9.755143 | 304 | 9.915035 | 146 | 9.840108 | 450 | 10.159892 | 10.084965 | 10.244857 | 19 |
| 42 | 9.755326 | 304 | 9.914948 | 146 | 9.840378 | 450 | 10.159622 | 10.085052 | 10.244674 | 18 |
| 43 | 9.755508 | 304 | 9.914860 | 146 | 9.840647 | 450 | 10.159353 | 10.085140 | 10.244492 | 17 |
| 44 | 9.755690 | 304 | 9.914773 | 146 | 9.840917 | 450 | 10.159083 | 10.085227 | 10.244310 | 16 |
| 45 | 9.755872 | 303 | 9.914685 | 146 | 9.841187 | 450 | 10.158813 | 10.085315 | 10.244128 | 15 |
| 46 | 9.756054 | 303 | 9.914598 | 146 | 9.841457 | 449 | 10.158543 | 10.085402 | 10.243946 | 14 |
| 47 | 9.756236 | 303 | 9.914510 | 146 | 9.841726 | 449 | 10.158274 | 10.085490 | 10.243764 | 13 |
| 48 | 9.756418 | 303 | 9.914422 | 146 | 9.841996 | 449 | 10.158004 | 10.085578 | 10.243582 | 12 |
| 49 | 9.756600 | 303 | 9.914334 | 146 | 9.842266 | 449 | 10.157734 | 10.085666 | 10.243400 | 11 |
| 50 | 9.756782 | 303 | 9.914246 | 146 | 9.842535 | 449 | 10.157465 | 10.085754 | 10.243218 | 10 |
| 51 | 9.756963 | 302 | 9.914158 | 147 | 9.842805 | 449 | 10.157195 | 10.085842 | 10.243037 | 9 |
| 52 | 9.757144 | 302 | 9.914070 | 147 | 9.843074 | 449 | 10.156926 | 10.085930 | 10.242856 | 8 |
| 53 | 9.757326 | 302 | 9.913982 | 147 | 9.843343 | 449 | 10.156657 | 10.086018 | 10.242674 | 7 |
| 54 | 9.757507 | 302 | 9.913894 | 147 | 9.843612 | 449 | 10.156388 | 10.086106 | 10.242493 | 6 |
| 55 | 9.757688 | 301 | 9.913806 | 147 | 9.843882 | 449 | 10.156118 | 10.086194 | 10.242312 | 5 |
| 56 | 9.757869 | 301 | 9.913718 | 147 | 9.844151 | 448 | 10.155849 | 10.086282 | 10.242131 | 4 |
| 57 | 9.758050 | 301 | 9.913630 | 147 | 9.844420 | 448 | 10.155580 | 10.086370 | 10.241950 | 3 |
| 58 | 9.758230 | 301 | 9.913541 | 147 | 9.844689 | 448 | 10.155311 | 10.086459 | 10.241770 | 2 |
| 59 | 9.758411 | 301 | 9.913453 | 147 | 9.844958 | 448 | 10.155042 | 10.086547 | 10.241589 | 1 |
| 60 | 9.758591 | | 9.913365 | | 9.845227 | | 10.154773 | 10.086635 | 10.241409 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 55 Degrees.

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## 35 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.758591 | 301 | 9.913365 | 147 | 9.845227 | 448 | 10.154773 | 10.086635 | 10.241409 | 60 |
| 1 | 9.758772 | 300 | 9.913276 | 147 | 9.845496 | 448 | 10.154504 | 10.086724 | 10.241228 | 59 |
| 2 | 9.758952 | 300 | 9.913187 | 148 | 9.845764 | 448 | 10.154236 | 10.086813 | 10.241048 | 58 |
| 3 | 9.759132 | 300 | 9.913099 | 148 | 9.846033 | 448 | 10.153967 | 10.086901 | 10.240868 | 57 |
| 4 | 9.759312 | 300 | 9.913010 | 148 | 9.846302 | 448 | 10.153698 | 10.086990 | 10.240688 | 56 |
| 5 | 9.759492 | 300 | 9.912922 | 148 | 9.846570 | 448 | 10.153430 | 10.087078 | 10.240508 | 55 |
| 6 | 9.759672 | 299 | 9.912833 | 148 | 9.846839 | 448 | 10.153161 | 10.087167 | 10.240328 | 54 |
| 7 | 9.759852 | 299 | 9.912744 | 148 | 9.847107 | 447 | 10.152893 | 10.087256 | 10.240148 | 53 |
| 8 | 9.760031 | 299 | 9.912655 | 148 | 9.847376 | 447 | 10.152624 | 10.087345 | 10.239969 | 52 |
| 9 | 9.760211 | 299 | 9.912566 | 148 | 9.847644 | 447 | 10.152356 | 10.087434 | 10.239789 | 51 |
| 10 | 9.760390 | 299 | 9.912477 | 148 | 9.847913 | 447 | 10.152087 | 10.087523 | 10.239610 | 50 |
| 11 | 9.760569 | 298 | 9.912388 | 148 | 9.848181 | 447 | 10.151819 | 10.087612 | 10.239431 | 49 |
| 12 | 9.760748 | 298 | 9.912299 | 149 | 9.848449 | 447 | 10.151551 | 10.087701 | 10.239252 | 48 |
| 13 | 9.760927 | 298 | 9.912210 | 149 | 9.848717 | 447 | 10.151283 | 10.087790 | 10.239073 | 47 |
| 14 | 9.761106 | 298 | 9.912121 | 149 | 9.848986 | 447 | 10.151014 | 10.087879 | 10.238894 | 46 |
| 15 | 9.761285 | 298 | 9.912031 | 149 | 9.849254 | 447 | 10.150746 | 10.087969 | 10.238715 | 45 |
| 16 | 9.761464 | 298 | 9.911942 | 149 | 9.849522 | 447 | 10.150478 | 10.088058 | 10.238536 | 44 |
| 17 | 9.761642 | 297 | 9.911853 | 149 | 9.849790 | 446 | 10.150210 | 10.088147 | 10.238358 | 43 |
| 18 | 9.761821 | 297 | 9.911763 | 149 | 9.850058 | 446 | 10.149942 | 10.088237 | 10.238179 | 42 |
| 19 | 9.761999 | 297 | 9.911674 | 149 | 9.850325 | 446 | 10.149675 | 10.088326 | 10.238001 | 41 |
| 20 | 9.762177 | 297 | 9.911584 | 149 | 9.850593 | 446 | 10.149407 | 10.088416 | 10.237823 | 40 |
| 21 | 9.762356 | 297 | 9.911495 | 149 | 9.850861 | 446 | 10.149139 | 10.088505 | 10.237644 | 39 |
| 22 | 9.762534 | 296 | 9.911405 | 149 | 9.851129 | 446 | 10.148871 | 10.088595 | 10.237466 | 38 |
| 23 | 9.762712 | 296 | 9.911315 | 150 | 9.851396 | 446 | 10.148604 | 10.088685 | 10.237288 | 37 |
| 24 | 9.762889 | 296 | 9.911226 | 150 | 9.851664 | 446 | 10.148336 | 10.088774 | 10.237111 | 36 |
| 25 | 9.763067 | 296 | 9.911136 | 150 | 9.851931 | 446 | 10.148069 | 10.088864 | 10.236933 | 35 |
| 26 | 9.763245 | 296 | 9.911046 | 150 | 9.852199 | 446 | 10.147801 | 10.088954 | 10.236755 | 34 |
| 27 | 9.763422 | 296 | 9.910956 | 150 | 9.852466 | 446 | 10.147534 | 10.089044 | 10.236578 | 33 |
| 28 | 9.763600 | 295 | 9.910866 | 150 | 9.852733 | 445 | 10.147267 | 10.089134 | 10.236400 | 32 |
| 29 | 9.763777 | 295 | 9.910776 | 150 | 9.853001 | 445 | 10.146999 | 10.089224 | 10.236223 | 31 |
| 30 | 9.763954 | 295 | 9.910686 | 150 | 9.853268 | 445 | 10.146732 | 10.089314 | 10.236046 | 30 |
| 31 | 9.764131 | 295 | 9.910596 | 150 | 9.853535 | 445 | 10.146465 | 10.089404 | 10.235869 | 29 |
| 32 | 9.764308 | 295 | 9.910506 | 150 | 9.853802 | 445 | 10.146198 | 10.089494 | 10.235692 | 28 |
| 33 | 9.764485 | 294 | 9.910415 | 150 | 9.854069 | 445 | 10.145931 | 10.089585 | 10.235515 | 27 |
| 34 | 9.764662 | 294 | 9.910325 | 151 | 9.854336 | 445 | 10.145664 | 10.089675 | 10.235338 | 26 |
| 35 | 9.764838 | 294 | 9.910235 | 151 | 9.854603 | 445 | 10.145397 | 10.089765 | 10.235162 | 25 |
| 36 | 9.765015 | 294 | 9.910144 | 151 | 9.854870 | 445 | 10.145130 | 10.089856 | 10.234985 | 24 |
| 37 | 9.765191 | 294 | 9.910054 | 151 | 9.855137 | 445 | 10.144863 | 10.089946 | 10.234809 | 23 |
| 38 | 9.765367 | 294 | 9.909963 | 151 | 9.855404 | 445 | 10.144596 | 10.090037 | 10.234633 | 22 |
| 39 | 9.765544 | 293 | 9.909873 | 151 | 9.855671 | 444 | 10.144329 | 10.090127 | 10.234456 | 21 |
| 40 | 9.765720 | 293 | 9.909782 | 151 | 9.855938 | 444 | 10.144062 | 10.090218 | 10.234280 | 20 |
| 41 | 9.765896 | 293 | 9.909691 | 151 | 9.856204 | 444 | 10.143796 | 10.090309 | 10.234104 | 19 |
| 42 | 9.766072 | 293 | 9.909601 | 151 | 9.856471 | 444 | 10.143529 | 10.090399 | 10.233928 | 18 |
| 43 | 9.766247 | 293 | 9.909510 | 151 | 9.856737 | 444 | 10.143263 | 10.090490 | 10.233753 | 17 |
| 44 | 9.766423 | 293 | 9.909419 | 151 | 9.857004 | 444 | 10.142996 | 10.090581 | 10.233577 | 16 |
| 45 | 9.766598 | 292 | 9.909328 | 152 | 9.857270 | 444 | 10.142730 | 10.090672 | 10.233402 | 15 |
| 46 | 9.766774 | 292 | 9.909237 | 152 | 9.857537 | 444 | 10.142463 | 10.090763 | 10.233226 | 14 |
| 47 | 9.766949 | 292 | 9.909146 | 152 | 9.857803 | 444 | 10.142197 | 10.090854 | 10.233051 | 13 |
| 48 | 9.767124 | 292 | 9.909055 | 152 | 9.858069 | 444 | 10.141931 | 10.090945 | 10.232876 | 12 |
| 49 | 9.767300 | 292 | 9.908964 | 152 | 9.858336 | 444 | 10.141664 | 10.091036 | 10.232700 | 11 |
| 50 | 9.767475 | 291 | 9.908873 | 152 | 9.858602 | 444 | 10.141398 | 10.091127 | 10.232525 | 10 |
| 51 | 9.767649 | 291 | 9.908781 | 152 | 9.858868 | 443 | 10.141132 | 10.091219 | 10.232351 | 9 |
| 52 | 9.767821 | 291 | 9.908690 | 152 | 9.859134 | 443 | 10.140866 | 10.091310 | 10.232176 | 8 |
| 53 | 9.767999 | 291 | 9.908599 | 152 | 9.859400 | 443 | 10.140600 | 10.091401 | 10.232001 | 7 |
| 54 | 9.768173 | 291 | 9.908507 | 152 | 9.859666 | 443 | 10.140334 | 10.091493 | 10.231827 | 6 |
| 55 | 9.768348 | 290 | 9.908416 | 152 | 9.859932 | 443 | 10.140068 | 10.091584 | 10.231652 | 5 |
| 56 | 9.768522 | 290 | 9.908324 | 153 | 9.860198 | 443 | 10.139802 | 10.091676 | 10.231478 | 4 |
| 57 | 9.768697 | 290 | 9.908233 | 153 | 9.860464 | 443 | 10.139536 | 10.091767 | 10.231303 | 3 |
| 58 | 9.768871 | 290 | 9.908141 | 153 | 9.860730 | 443 | 10.139270 | 10.091859 | 10.231129 | 2 |
| 59 | 9.769045 | 290 | 9.908049 | 153 | 9.860995 | 443 | 10.139005 | 10.091951 | 10.230955 | 1 |
| 60 | 9.769219 | | 9.907958 | | 9.861261 | | 10.138739 | 10.092042 | 10.230781 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 36 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.769219 | 290 | 9.907958 | 153 | 9.861261 | 443 | 10.138739 | 10.092042 | 10.230781 | 60 |
| 1 | 9.769393 | 289 | 9.907866 | 153 | 9.861527 | 443 | 10.138473 | 10.092134 | 10.230607 | 59 |
| 2 | 9.769566 | 289 | 9.907774 | 153 | 9.861792 | 443 | 10.138208 | 10.092226 | 10.230434 | 58 |
| 3 | 9.769740 | 289 | 9.907682 | 153 | 9.862058 | 442 | 10.137942 | 10.092318 | 10.230260 | 57 |
| 4 | 9.769913 | 289 | 9.907590 | 153 | 9.862323 | 442 | 10.137677 | 10.092410 | 10.230087 | 56 |
| 5 | 9.770087 | 289 | 9.907498 | 153 | 9.862589 | 442 | 10.137411 | 10.092502 | 10.229913 | 55 |
| 6 | 9.770260 | 289 | 9.907406 | 153 | 9.862854 | 442 | 10.137146 | 10.092594 | 10.229740 | 54 |
| 7 | 9.770433 | 288 | 9.907314 | 153 | 9.863119 | 442 | 10.136881 | 10.092686 | 10.229567 | 53 |
| 8 | 9.770606 | 288 | 9.907222 | 154 | 9.863385 | 442 | 10.136615 | 10.092778 | 10.229394 | 52 |
| 9 | 9.770779 | 288 | 9.907129 | 154 | 9.863650 | 442 | 10.136350 | 10.092871 | 10.229221 | 51 |
| 10 | 9.770952 | 288 | 9.907037 | 154 | 9.863915 | 442 | 10.136085 | 10.092963 | 10.229048 | 50 |
| 11 | 9.771125 | 288 | 9.906945 | 154 | 9.864180 | 442 | 10.135820 | 10.093055 | 10.228875 | 49 |
| 12 | 9.771298 | 287 | 9.906852 | 154 | 9.864445 | 442 | 10.135555 | 10.093148 | 10.228702 | 48 |
| 13 | 9.771470 | 287 | 9.906760 | 154 | 9.864710 | 442 | 10.135290 | 10.093240 | 10.228530 | 47 |
| 14 | 9.771643 | 287 | 9.906667 | 154 | 9.864975 | 442 | 10.135025 | 10.093333 | 10.228357 | 46 |
| 15 | 9.771815 | 287 | 9.906575 | 154 | 9.865240 | 441 | 10.134760 | 10.093425 | 10.228185 | 45 |
| 16 | 9.771987 | 287 | 9.906482 | 154 | 9.865505 | 441 | 10.134495 | 10.093518 | 10.228013 | 44 |
| 17 | 9.772159 | 287 | 9.906389 | 154 | 9.865770 | 441 | 10.134230 | 10.093611 | 10.227841 | 43 |
| 18 | 9.772331 | 286 | 9.906296 | 155 | 9.866035 | 441 | 10.133965 | 10.093704 | 10.227669 | 42 |
| 19 | 9.772503 | 286 | 9.906204 | 155 | 9.866300 | 441 | 10.133700 | 10.093796 | 10.227497 | 41 |
| 20 | 9.772675 | 286 | 9.906111 | 155 | 9.866564 | 441 | 10.133436 | 10.093889 | 10.227325 | 40 |
| 21 | 9.772847 | 286 | 9.906018 | 155 | 9.866829 | 441 | 10.133171 | 10.093982 | 10.227153 | 39 |
| 22 | 9.773018 | 286 | 9.905925 | 155 | 9.867094 | 441 | 10.132906 | 10.094075 | 10.226982 | 38 |
| 23 | 9.773190 | 286 | 9.905832 | 155 | 9.867358 | 441 | 10.132642 | 10.094168 | 10.226810 | 37 |
| 24 | 9.773361 | 285 | 9.905739 | 155 | 9.867623 | 441 | 10.132377 | 10.094261 | 10.226639 | 36 |
| 25 | 9.773533 | 285 | 9.905645 | 155 | 9.867887 | 441 | 10.132113 | 10.094355 | 10.226467 | 35 |
| 26 | 9.773704 | 285 | 9.905552 | 155 | 9.868152 | 441 | 10.131848 | 10.094448 | 10.226296 | 34 |
| 27 | 9.773875 | 285 | 9.905459 | 155 | 9.868416 | 441 | 10.131584 | 10.094541 | 10.226125 | 33 |
| 28 | 9.774046 | 285 | 9.905366 | 156 | 9.868680 | 440 | 10.131320 | 10.094634 | 10.225954 | 32 |
| 29 | 9.774217 | 285 | 9.905272 | 156 | 9.868945 | 440 | 10.131055 | 10.094728 | 10.225783 | 31 |
| 30 | 9.774388 | 285 | 9.905179 | 156 | 9.869209 | 440 | 10.130791 | 10.094821 | 10.225612 | 30 |
| 31 | 9.774558 | 284 | 9.905085 | 156 | 9.869473 | 440 | 10.130527 | 10.094915 | 10.225442 | 29 |
| 32 | 9.774729 | 284 | 9.904992 | 156 | 9.869737 | 440 | 10.130263 | 10.095008 | 10.225271 | 28 |
| 33 | 9.774899 | 284 | 9.904898 | 156 | 9.870001 | 440 | 10.129999 | 10.095102 | 10.225101 | 27 |
| 34 | 9.775070 | 284 | 9.904804 | 156 | 9.870265 | 440 | 10.129735 | 10.095196 | 10.224930 | 26 |
| 35 | 9.775240 | 284 | 9.904711 | 156 | 9.870529 | 440 | 10.129471 | 10.095289 | 10.224760 | 25 |
| 36 | 9.775410 | 283 | 9.904617 | 156 | 9.870793 | 440 | 10.129207 | 10.095383 | 10.224590 | 24 |
| 37 | 9.775580 | 283 | 9.904523 | 156 | 9.871057 | 440 | 10.128943 | 10.095477 | 10.224420 | 23 |
| 38 | 9.775750 | 283 | 9.904429 | 157 | 9.871321 | 440 | 10.128679 | 10.095571 | 10.224250 | 22 |
| 39 | 9.775920 | 283 | 9.904335 | 157 | 9.871585 | 440 | 10.128415 | 10.095665 | 10.224080 | 21 |
| 40 | 9.776090 | 283 | 9.904241 | 157 | 9.871849 | 440 | 10.128151 | 10.095759 | 10.223910 | 20 |
| 41 | 9.776259 | 283 | 9.904147 | 157 | 9.872112 | 439 | 10.127888 | 10.095853 | 10.223741 | 19 |
| 42 | 9.776429 | 282 | 9.904053 | 157 | 9.872376 | 439 | 10.127624 | 10.095947 | 10.223571 | 18 |
| 43 | 9.776598 | 282 | 9.903959 | 157 | 9.872640 | 439 | 10.127360 | 10.096041 | 10.223402 | 17 |
| 44 | 9.776768 | 282 | 9.903864 | 157 | 9.872903 | 439 | 10.127097 | 10.096136 | 10.223232 | 16 |
| 45 | 9.776937 | 282 | 9.903770 | 157 | 9.873167 | 439 | 10.126833 | 10.096230 | 10.223063 | 15 |
| 46 | 9.777106 | 282 | 9.903676 | 157 | 9.873430 | 439 | 10.126570 | 10.096324 | 10.222894 | 14 |
| 47 | 9.777275 | 281 | 9.903581 | 157 | 9.873694 | 439 | 10.126306 | 10.096419 | 10.222725 | 13 |
| 48 | 9.777444 | 281 | 9.903487 | 157 | 9.873957 | 439 | 10.126043 | 10.096513 | 10.222556 | 12 |
| 49 | 9.777613 | 281 | 9.903392 | 158 | 9.874220 | 439 | 10.125780 | 10.096608 | 10.222387 | 11 |
| 50 | 9.777781 | 281 | 9.903298 | 158 | 9.874484 | 439 | 10.125516 | 10.096702 | 10.222219 | 10 |
| 51 | 9.777950 | 281 | 9.903203 | 158 | 9.874747 | 439 | 10.125253 | 10.096797 | 10.222050 | 9 |
| 52 | 9.778119 | 281 | 9.903108 | 158 | 9.875010 | 439 | 10.124990 | 10.096892 | 10.221881 | 8 |
| 53 | 9.778287 | 280 | 9.903014 | 158 | 9.875273 | 439 | 10.124727 | 10.096986 | 10.221713 | 7 |
| 54 | 9.778455 | 280 | 9.902919 | 158 | 9.875536 | 439 | 10.124464 | 10.097081 | 10.221545 | 6 |
| 55 | 9.778624 | 280 | 9.902824 | 158 | 9.875800 | 438 | 10.124200 | 10.097176 | 10.221376 | 5 |
| 56 | 9.778792 | 280 | 9.902729 | 158 | 9.876063 | 438 | 10.123937 | 10.097271 | 10.221208 | 4 |
| 57 | 9.778960 | 280 | 9.902634 | 158 | 9.876326 | 438 | 10.123674 | 10.097366 | 10.221040 | 3 |
| 58 | 9.779128 | 280 | 9.902539 | 159 | 9.876589 | 438 | 10.123411 | 10.097461 | 10.220872 | 2 |
| 59 | 9.779295 | 279 | 9.902444 | 159 | 9.876851 | 438 | 10.123149 | 10.097556 | 10.220705 | 1 |
| 60 | 9.779463 | | 9.902349 | | 9.877114 | | 10.122886 | 10.097661 | 10.220537 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 53 Degrees.

## 37 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.779463 | | 9.902349 | | 9.877114 | | 10.122886 | 10.097651 | 10.220537 | 60 |
| 1 | 9.779631 | 279 | 9.902253 | 159 | 9.877377 | 438 | 10.122623 | 10.097747 | 10.220369 | 59 |
| 2 | 9.779798 | 279 | 9.902158 | 159 | 9.877640 | 438 | 10.122360 | 10.097842 | 10.220202 | 58 |
| 3 | 9.779966 | 279 | 9.902063 | 159 | 9.877903 | 438 | 10.122097 | 10.097937 | 10.220034 | 57 |
| 4 | 9.780133 | 279 | 9.901967 | 159 | 9.878165 | 438 | 10.121835 | 10.098033 | 10.219867 | 56 |
| 5 | 9.780300 | 278 | 9.901872 | 159 | 9.878428 | 438 | 10.121572 | 10.098128 | 10.219700 | 55 |
| 6 | 9.780467 | 278 | 9.901776 | 159 | 9.878691 | 438 | 10.121309 | 10.098224 | 10.219533 | 54 |
| 7 | 9.780634 | 278 | 9.901681 | 159 | 9.878953 | 437 | 10.121047 | 10.098319 | 10.219366 | 53 |
| 8 | 9.780801 | 278 | 9.901585 | 159 | 9.879216 | 437 | 10.120784 | 10.098415 | 10.219199 | 52 |
| 9 | 9.780968 | 278 | 9.901490 | 159 | 9.879478 | 437 | 10.120522 | 10.098510 | 10.219032 | 51 |
| 10 | 9.781134 | 278 | 9.901394 | 159 | 9.879741 | 437 | 10.120259 | 10.098606 | 10.218866 | 50 |
| 11 | 9.781301 | 277 | 9.901298 | 160 | 9.880003 | 437 | 10.119997 | 10.098702 | 10.218699 | 49 |
| 12 | 9.781468 | 277 | 9.901202 | 160 | 9.880265 | 437 | 10.119735 | 10.098798 | 10.218532 | 48 |
| 13 | 9.781634 | 277 | 9.901106 | 160 | 9.880528 | 437 | 10.119472 | 10.098894 | 10.218366 | 47 |
| 14 | 9.781800 | 277 | 9.901010 | 160 | 9.880790 | 437 | 10.119210 | 10.098990 | 10.218200 | 46 |
| 15 | 9.781966 | 277 | 9.900914 | 160 | 9.881052 | 437 | 10.118948 | 10.099086 | 10.218034 | 45 |
| 16 | 9.782132 | 277 | 9.900818 | 160 | 9.881314 | 437 | 10.118686 | 10.099182 | 10.217868 | 44 |
| 17 | 9.782298 | 276 | 9.900722 | 160 | 9.881576 | 437 | 10.118424 | 10.099278 | 10.217702 | 43 |
| 18 | 9.782464 | 276 | 9.900626 | 160 | 9.881839 | 437 | 10.118161 | 10.099374 | 10.217536 | 42 |
| 19 | 9.782630 | 276 | 9.900529 | 160 | 9.882101 | 437 | 10.117899 | 10.099471 | 10.217370 | 41 |
| 20 | 9.782796 | 276 | 9.900433 | 161 | 9.882363 | 437 | 10.117637 | 10.099567 | 10.217204 | 40 |
| 21 | 9.782961 | 276 | 9.900337 | 161 | 9.882625 | 436 | 10.117375 | 10.099663 | 10.217039 | 39 |
| 22 | 9.783127 | 276 | 9.900240 | 161 | 9.882887 | 436 | 10.117113 | 10.099760 | 10.216873 | 38 |
| 23 | 9.783292 | 275 | 9.900144 | 161 | 9.883148 | 436 | 10.116852 | 10.099856 | 10.216708 | 37 |
| 24 | 9.783458 | 275 | 9.900047 | 161 | 9.883410 | 436 | 10.116590 | 10.099953 | 10.216542 | 36 |
| 25 | 9.783623 | 275 | 9.899951 | 161 | 9.883672 | 436 | 10.116328 | 10.100049 | 10.216377 | 35 |
| 26 | 9.783788 | 275 | 9.899854 | 161 | 9.883934 | 436 | 10.116066 | 10.100146 | 10.216212 | 34 |
| 27 | 9.783953 | 275 | 9.899757 | 161 | 9.884196 | 436 | 10.115804 | 10.100243 | 10.216047 | 33 |
| 28 | 9.784118 | 275 | 9.899660 | 161 | 9.884457 | 436 | 10.115543 | 10.100340 | 10.215882 | 32 |
| 29 | 9.784282 | 275 | 9.899564 | 161 | 9.884719 | 436 | 10.115281 | 10.100436 | 10.215718 | 31 |
| 30 | 9.784447 | 274 | 9.899467 | 162 | 9.884980 | 436 | 10.115020 | 10.100533 | 10.215553 | 30 |
| 31 | 9.784612 | 274 | 9.899370 | 162 | 9.885242 | 436 | 10.114758 | 10.100630 | 10.215388 | 29 |
| 32 | 9.784776 | 274 | 9.899273 | 162 | 9.885503 | 436 | 10.114497 | 10.100727 | 10.215224 | 28 |
| 33 | 9.784941 | 274 | 9.899176 | 162 | 9.885765 | 436 | 10.114235 | 10.100824 | 10.215059 | 27 |
| 34 | 9.785105 | 274 | 9.899078 | 162 | 9.886026 | 436 | 10.113974 | 10.100922 | 10.214895 | 26 |
| 35 | 9.785269 | 273 | 9.898981 | 162 | 9.886288 | 436 | 10.113712 | 10.101019 | 10.214731 | 25 |
| 36 | 9.785433 | 273 | 9.898884 | 162 | 9.886549 | 436 | 10.113451 | 10.101116 | 10.214567 | 24 |
| 37 | 9.785597 | 273 | 9.898787 | 162 | 9.886810 | 435 | 10.113190 | 10.101213 | 10.214403 | 23 |
| 38 | 9.785761 | 273 | 9.898689 | 162 | 9.887072 | 435 | 10.112928 | 10.101311 | 10.214239 | 22 |
| 39 | 9.785925 | 273 | 9.898592 | 162 | 9.887333 | 435 | 10.112667 | 10.101408 | 10.214075 | 21 |
| 40 | 9.786089 | 273 | 9.898494 | 163 | 9.887594 | 435 | 10.112406 | 10.101506 | 10.213911 | 20 |
| 41 | 9.786252 | 272 | 9.898397 | 163 | 9.887855 | 435 | 10.112145 | 10.101603 | 10.213748 | 19 |
| 42 | 9.786416 | 272 | 9.898299 | 163 | 9.888116 | 435 | 10.111884 | 10.101701 | 10.213584 | 18 |
| 43 | 9.786579 | 272 | 9.898202 | 163 | 9.888377 | 435 | 10.111623 | 10.101798 | 10.213421 | 17 |
| 44 | 9.786742 | 272 | 9.898104 | 163 | 9.888639 | 435 | 10.111361 | 10.101896 | 10.213258 | 16 |
| 45 | 9.786906 | 272 | 9.898006 | 163 | 9.888900 | 435 | 10.111100 | 10.101994 | 10.213094 | 15 |
| 46 | 9.787069 | 272 | 9.897908 | 163 | 9.889160 | 435 | 10.110840 | 10.102092 | 10.212931 | 14 |
| 47 | 9.787232 | 271 | 9.897810 | 163 | 9.889421 | 435 | 10.110579 | 10.102190 | 10.212768 | 13 |
| 48 | 9.787395 | 271 | 9.897712 | 163 | 9.889682 | 435 | 10.110318 | 10.102288 | 10.212605 | 12 |
| 49 | 9.787557 | 271 | 9.897614 | 163 | 9.889943 | 435 | 10.110057 | 10.102386 | 10.212443 | 11 |
| 50 | 9.787720 | 271 | 9.897516 | 163 | 9.890201 | 435 | 10.109796 | 10.102484 | 10.212280 | 10 |
| 51 | 9.787883 | 271 | 9.897418 | 164 | 9.890465 | 435 | 10.109535 | 10.102582 | 10.212117 | 9 |
| 52 | 9.788045 | 271 | 9.897320 | 164 | 9.890725 | 434 | 10.109275 | 10.102680 | 10.211955 | 8 |
| 53 | 9.788208 | 271 | 9.897222 | 164 | 9.890986 | 434 | 10.109014 | 10.102778 | 10.211792 | 7 |
| 54 | 9.788370 | 270 | 9.897123 | 164 | 9.891247 | 434 | 10.108753 | 10.102877 | 10.211630 | 6 |
| 55 | 9.788532 | 270 | 9.897025 | 164 | 9.891507 | 434 | 10.108493 | 10.102975 | 10.211468 | 5 |
| 56 | 9.788694 | 270 | 9.896926 | 164 | 9.891768 | 434 | 10.108232 | 10.103074 | 10.211306 | 4 |
| 57 | 9.788856 | 270 | 9.896828 | 164 | 9.892028 | 434 | 10.107972 | 10.103172 | 10.211144 | 3 |
| 58 | 9.789018 | 270 | 9.896729 | 164 | 9.892289 | 434 | 10.107711 | 10.103271 | 10.210982 | 2 |
| 59 | 9.789180 | 270 | 9.896631 | 164 | 9.892549 | 434 | 10.107451 | 10.103369 | 10.210820 | 1 |
| 60 | 9.789342 | | 9.896532 | | 9.892810 | | 10.107190 | 10.103468 | 10.210658 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 52 Degrees.

38 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.789342 | 269 | 9.896532 | 164 | 9.892810 | 434 | 10.107190 | 10.103468 | 10.210658 | 60 |
| 1 | 9.789504 | 269 | 9.896433 | 165 | 9.893070 | 434 | 10.106930 | 10.103567 | 10.210496 | 59 |
| 2 | 9.789665 | 269 | 9.896335 | 165 | 9.893331 | 434 | 10.106669 | 10.103665 | 10.210335 | 58 |
| 3 | 9.789827 | 269 | 9.896236 | 165 | 9.893591 | 434 | 10.106409 | 10.103764 | 10.210173 | 57 |
| 4 | 9.789988 | 269 | 9.896137 | 165 | 9.893851 | 434 | 10.106149 | 10.103863 | 10.210012 | 56 |
| 5 | 9.790149 | 269 | 9.896038 | 165 | 9.894111 | 434 | 10.105889 | 10.103962 | 10.209851 | 55 |
| 6 | 9.790310 | 269 | 9.895939 | 165 | 9.894371 | 434 | 10.105629 | 10.104061 | 10.209690 | 54 |
| 7 | 9.790471 | 268 | 9.895840 | 165 | 9.894632 | 434 | 10.105368 | 10.104160 | 10.209529 | 53 |
| 8 | 9.790632 | 268 | 9.895741 | 165 | 9.894892 | 433 | 10.105108 | 10.104259 | 10.209368 | 52 |
| 9 | 9.790793 | 268 | 9.895641 | 165 | 9.895152 | 433 | 10.104848 | 10.104359 | 10.209207 | 51 |
| 10 | 9.790954 | 268 | 9.895542 | 165 | 9.895412 | 433 | 10.104588 | 10.104458 | 10.209046 | 50 |
| 11 | 9.791115 | 268 | 9.895443 | 166 | 9.895672 | 433 | 10.104328 | 10.104557 | 10.208885 | 49 |
| 12 | 9.791275 | 267 | 9.895343 | 166 | 9.895932 | 433 | 10.104068 | 10.104657 | 10.208725 | 48 |
| 13 | 9.791436 | 267 | 9.895244 | 166 | 9.896192 | 433 | 10.103808 | 10.104756 | 10.208564 | 47 |
| 14 | 9.791596 | 267 | 9.895145 | 166 | 9.896452 | 433 | 10.103548 | 10.104855 | 10.208404 | 46 |
| 15 | 9.791757 | 267 | 9.895045 | 166 | 9.896712 | 433 | 10.103288 | 10.104955 | 10.208243 | 45 |
| 16 | 9.791917 | 267 | 9.894945 | 166 | 9.896971 | 433 | 10.103029 | 10.105055 | 10.208083 | 44 |
| 17 | 9.792077 | 267 | 9.894846 | 166 | 9.897231 | 433 | 10.102769 | 10.105154 | 10.207923 | 43 |
| 18 | 9.792237 | 266 | 9.894746 | 166 | 9.897491 | 433 | 10.102509 | 10.105254 | 10.207763 | 42 |
| 19 | 9.792397 | 266 | 9.894646 | 166 | 9.897751 | 433 | 10.102249 | 10.105354 | 10.207603 | 41 |
| 20 | 9.792557 | 266 | 9.894546 | 166 | 9.898010 | 433 | 10.101990 | 10.105454 | 10.207443 | 40 |
| 21 | 9.792716 | 266 | 9.894446 | 167 | 9.898270 | 433 | 10.101730 | 10.105554 | 10.207284 | 39 |
| 22 | 9.792876 | 266 | 9.894346 | 167 | 9.898530 | 433 | 10.101470 | 10.105654 | 10.207124 | 38 |
| 23 | 9.793035 | 266 | 9.894246 | 167 | 9.898789 | 433 | 10.101211 | 10.105754 | 10.206965 | 37 |
| 24 | 9.793195 | 266 | 9.894146 | 167 | 9.899049 | 432 | 10.100951 | 10.105854 | 10.206805 | 36 |
| 25 | 9.793354 | 265 | 9.894046 | 167 | 9.899308 | 432 | 10.100692 | 10.105954 | 10.206646 | 35 |
| 26 | 9.793514 | 265 | 9.893946 | 167 | 9.899568 | 432 | 10.100432 | 10.106054 | 10.206486 | 34 |
| 27 | 9.793673 | 265 | 9.893846 | 167 | 9.899827 | 432 | 10.100173 | 10.106154 | 10.206327 | 33 |
| 28 | 9.793832 | 265 | 9.893745 | 167 | 9.900086 | 432 | 10.099914 | 10.106255 | 10.206168 | 32 |
| 29 | 9.793991 | 265 | 9.893645 | 167 | 9.900346 | 432 | 10.099654 | 10.106355 | 10.206009 | 31 |
| 30 | 9.794150 | 264 | 9.893544 | 167 | 9.900605 | 432 | 10.099395 | 10.106456 | 10.205850 | 30 |
| 31 | 9.794308 | 264 | 9.893444 | 168 | 9.900864 | 432 | 10.099136 | 10.106556 | 10.205692 | 29 |
| 32 | 9.794467 | 264 | 9.893343 | 168 | 9.901124 | 432 | 10.098876 | 10.106657 | 10.205533 | 28 |
| 33 | 9.794626 | 264 | 9.893243 | 168 | 9.901383 | 432 | 10.098617 | 10.106757 | 10.205374 | 27 |
| 34 | 9.794784 | 264 | 9.893142 | 168 | 9.901642 | 432 | 10.098358 | 10.106858 | 10.205216 | 26 |
| 35 | 9.794942 | 264 | 9.893041 | 168 | 9.901901 | 432 | 10.098099 | 10.106959 | 10.205058 | 25 |
| 36 | 9.795101 | 264 | 9.892940 | 168 | 9.902160 | 432 | 10.097840 | 10.107060 | 10.204899 | 24 |
| 37 | 9.795259 | 263 | 9.892839 | 168 | 9.902419 | 432 | 10.097581 | 10.107161 | 10.204741 | 23 |
| 38 | 9.795417 | 263 | 9.892739 | 168 | 9.902679 | 432 | 10.097321 | 10.107261 | 10.204583 | 22 |
| 39 | 9.795575 | 263 | 9.892638 | 168 | 9.902938 | 432 | 10.097062 | 10.107362 | 10.204425 | 21 |
| 40 | 9.795733 | 263 | 9.892536 | 168 | 9.903197 | 432 | 10.096803 | 10.107464 | 10.204267 | 20 |
| 41 | 9.795891 | 263 | 9.892435 | 169 | 9.903455 | 431 | 10.096545 | 10.107565 | 10.204109 | 19 |
| 42 | 9.796049 | 263 | 9.892334 | 169 | 9.903714 | 431 | 10.096286 | 10.107666 | 10.203951 | 18 |
| 43 | 9.796206 | 263 | 9.892233 | 169 | 9.903973 | 431 | 10.096027 | 10.107767 | 10.203794 | 17 |
| 44 | 9.796364 | 262 | 9.892132 | 169 | 9.904232 | 431 | 10.095768 | 10.107868 | 10.203636 | 16 |
| 45 | 9.796521 | 262 | 9.892030 | 169 | 9.904491 | 431 | 10.095509 | 10.107970 | 10.203479 | 15 |
| 46 | 9.796679 | 262 | 9.891929 | 169 | 9.904750 | 431 | 10.095250 | 10.108071 | 10.203321 | 14 |
| 47 | 9.796836 | 262 | 9.891827 | 169 | 9.905008 | 431 | 10.094992 | 10.108173 | 10.203164 | 13 |
| 48 | 9.796993 | 262 | 9.891726 | 169 | 9.905267 | 431 | 10.094733 | 10.108274 | 10.203007 | 12 |
| 49 | 9.797150 | 262 | 9.891624 | 169 | 9.905526 | 431 | 10.094474 | 10.108376 | 10.202850 | 11 |
| 50 | 9.797307 | 262 | 9.891523 | 169 | 9.905784 | 431 | 10.094216 | 10.108477 | 10.202693 | 10 |
| 51 | 9.797464 | 261 | 9.891421 | 170 | 9.906043 | 431 | 10.093957 | 10.108579 | 10.202536 | 9 |
| 52 | 9.797621 | 261 | 9.891319 | 170 | 9.906302 | 431 | 10.093698 | 10.108681 | 10.202379 | 8 |
| 53 | 9.797777 | 261 | 9.891217 | 170 | 9.906560 | 431 | 10.093440 | 10.108783 | 10.202223 | 7 |
| 54 | 9.797934 | 261 | 9.891115 | 170 | 9.906819 | 431 | 10.093181 | 10.108885 | 10.202066 | 6 |
| 55 | 9.798091 | 261 | 9.891013 | 170 | 9.907077 | 431 | 10.092923 | 10.108987 | 10.201909 | 5 |
| 56 | 9.798247 | 261 | 9.890911 | 170 | 9.907336 | 431 | 10.092664 | 10.109089 | 10.201753 | 4 |
| 57 | 9.798403 | 260 | 9.890809 | 170 | 9.907594 | 431 | 10.092406 | 10.109191 | 10.201597 | 3 |
| 58 | 9.798560 | 260 | 9.890707 | 170 | 9.907852 | 431 | 10.092148 | 10.109293 | 10.201440 | 2 |
| 59 | 9.798716 | 260 | 9.890605 | 170 | 9.908111 | 431 | 10.091889 | 10.109395 | 10.201284 | 1 |
| 60 | 9.798872 | | 9.890503 | | 9.908369 | | 10.091631 | 10.109497 | 10.201128 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

51 Degrees.

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# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 39 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.798872 | 260 | 9.890503 | 170 | 9.908369 | 430 | 10.091631 | 10.109497 | 10.201128 | 60 |
| 1 | 9.799028 | 260 | 9.890400 | 171 | 9.908628 | 430 | 10.091372 | 10.109600 | 10.200972 | 59 |
| 2 | 9.799184 | 260 | 9.890298 | 171 | 9.908886 | 430 | 10.091114 | 10.109702 | 10.200816 | 58 |
| 3 | 9.799339 | 259 | 9.890195 | 171 | 9.909144 | 430 | 10.090856 | 10.109805 | 10.200661 | 57 |
| 4 | 9.799495 | 259 | 9.890093 | 171 | 9.909402 | 430 | 10.090598 | 10.109907 | 10.200505 | 56 |
| 5 | 9.799651 | 259 | 9.889990 | 171 | 9.909660 | 430 | 10.090340 | 10.110010 | 10.200349 | 55 |
| 6 | 9.799806 | 259 | 9.889888 | 171 | 9.909918 | 430 | 10.090082 | 10.110112 | 10.200194 | 54 |
| 7 | 9.799962 | 259 | 9.889785 | 171 | 9.910177 | 430 | 10.089823 | 10.110215 | 10.200038 | 53 |
| 8 | 9.800117 | 259 | 9.889682 | 171 | 9.910435 | 430 | 10.089565 | 10.110318 | 10.199883 | 52 |
| 9 | 9.800272 | 258 | 9.889579 | 171 | 9.910693 | 430 | 10.089307 | 10.110421 | 10.199728 | 51 |
| 10 | 9.800427 | 258 | 9.889477 | 171 | 9.910951 | 430 | 10.089049 | 10.110523 | 10.199573 | 50 |
| 11 | 9.800582 | 258 | 9.889374 | 172 | 9.911209 | 430 | 10.088791 | 10.110626 | 10.199418 | 49 |
| 12 | 9.800737 | 258 | 9.889271 | 172 | 9.911467 | 430 | 10.088533 | 10.110729 | 10.199263 | 48 |
| 13 | 9.800892 | 258 | 9.889168 | 172 | 9.911724 | 430 | 10.088276 | 10.110832 | 10.199108 | 47 |
| 14 | 9.801047 | 258 | 9.889064 | 172 | 9.911982 | 430 | 10.088018 | 10.110936 | 10.198953 | 46 |
| 15 | 9.801201 | 258 | 9.888961 | 172 | 9.912240 | 430 | 10.087760 | 10.111039 | 10.198799 | 45 |
| 16 | 9.801356 | 257 | 9.888858 | 172 | 9.912498 | 430 | 10.087502 | 10.111142 | 10.198644 | 44 |
| 17 | 9.801511 | 257 | 9.888755 | 172 | 9.912756 | 430 | 10.087244 | 10.111245 | 10.198489 | 43 |
| 18 | 9.801665 | 257 | 9.888651 | 172 | 9.913014 | 430 | 10.086986 | 10.111349 | 10.198335 | 42 |
| 19 | 9.801819 | 257 | 9.888548 | 172 | 9.913271 | 429 | 10.086729 | 10.111452 | 10.198181 | 41 |
| 20 | 9.801973 | 257 | 9.888444 | 173 | 9.913529 | 429 | 10.086471 | 10.111556 | 10.198027 | 40 |
| 21 | 9.802128 | 257 | 9.888341 | 173 | 9.913787 | 429 | 10.086213 | 10.111659 | 10.197872 | 39 |
| 22 | 9.802282 | 256 | 9.888237 | 173 | 9.914044 | 429 | 10.085956 | 10.111763 | 10.197718 | 38 |
| 23 | 9.802436 | 256 | 9.888134 | 173 | 9.914302 | 429 | 10.085698 | 10.111866 | 10.197564 | 37 |
| 24 | 9.802589 | 256 | 9.888030 | 173 | 9.914560 | 429 | 10.085440 | 10.111970 | 10.197411 | 36 |
| 25 | 9.802743 | 256 | 9.887926 | 173 | 9.914817 | 429 | 10.085183 | 10.112074 | 10.197257 | 35 |
| 26 | 9.802897 | 256 | 9.887822 | 173 | 9.915075 | 429 | 10.084925 | 10.112178 | 10.197103 | 34 |
| 27 | 9.803050 | 256 | 9.887718 | 173 | 9.915332 | 429 | 10.084668 | 10.112282 | 10.196950 | 33 |
| 28 | 9.803204 | 256 | 9.887614 | 173 | 9.915590 | 429 | 10.084410 | 10.112386 | 10.196796 | 32 |
| 29 | 9.803357 | 255 | 9.887510 | 173 | 9.915847 | 429 | 10.084153 | 10.112490 | 10.196643 | 31 |
| 30 | 9.803511 | 255 | 9.887406 | 174 | 9.916104 | 429 | 10.083896 | 10.112594 | 10.196489 | 30 |
| 31 | 9.803664 | 255 | 9.887302 | 174 | 9.916362 | 429 | 10.083638 | 10.112698 | 10.196336 | 29 |
| 32 | 9.803817 | 255 | 9.887198 | 174 | 9.916619 | 429 | 10.083381 | 10.112802 | 10.196183 | 28 |
| 33 | 9.803970 | 255 | 9.887093 | 174 | 9.916877 | 429 | 10.083123 | 10.112907 | 10.196030 | 27 |
| 34 | 9.804123 | 255 | 9.886989 | 174 | 9.917134 | 429 | 10.082866 | 10.113011 | 10.195877 | 26 |
| 35 | 9.804276 | 254 | 9.886885 | 174 | 9.917391 | 429 | 10.082609 | 10.113115 | 10.195724 | 25 |
| 36 | 9.804428 | 254 | 9.886780 | 174 | 9.917648 | 429 | 10.082352 | 10.113220 | 10.195572 | 24 |
| 37 | 9.804581 | 254 | 9.886676 | 174 | 9.917905 | 429 | 10.082095 | 10.113324 | 10.195419 | 23 |
| 38 | 9.804734 | 254 | 9.886571 | 174 | 9.918163 | 429 | 10.081837 | 10.113429 | 10.195266 | 22 |
| 39 | 9.804886 | 254 | 9.886466 | 174 | 9.918420 | 429 | 10.081580 | 10.113534 | 10.195114 | 21 |
| 40 | 9.805039 | 254 | 9.886362 | 175 | 9.918677 | 429 | 10.081323 | 10.113638 | 10.194961 | 20 |
| 41 | 9.805191 | 254 | 9.886257 | 175 | 9.918934 | 428 | 10.081066 | 10.113743 | 10.194809 | 19 |
| 42 | 9.805343 | 253 | 9.886152 | 175 | 9.919191 | 428 | 10.080809 | 10.113848 | 10.194657 | 18 |
| 43 | 9.805495 | 253 | 9.886047 | 175 | 9.919448 | 428 | 10.080552 | 10.113953 | 10.194505 | 17 |
| 44 | 9.805647 | 253 | 9.885942 | 175 | 9.919705 | 428 | 10.080295 | 10.114058 | 10.194353 | 16 |
| 45 | 9.805799 | 253 | 9.885837 | 175 | 9.919962 | 428 | 10.080038 | 10.114163 | 10.194201 | 15 |
| 46 | 9.805951 | 253 | 9.885732 | 175 | 9.920219 | 428 | 10.079781 | 10.114268 | 10.194049 | 14 |
| 47 | 9.806103 | 253 | 9.885627 | 175 | 9.920476 | 428 | 10.079524 | 10.114373 | 10.193897 | 13 |
| 48 | 9.806254 | 253 | 9.885522 | 175 | 9.920733 | 428 | 10.079267 | 10.114478 | 10.193746 | 12 |
| 49 | 9.806406 | 252 | 9.885416 | 175 | 9.920990 | 428 | 10.079010 | 10.114584 | 10.193594 | 11 |
| 50 | 9.806557 | 252 | 9.885311 | 176 | 9.921247 | 428 | 10.078753 | 10.114689 | 10.193443 | 10 |
| 51 | 9.806709 | 252 | 9.885205 | 176 | 9.921503 | 428 | 10.078497 | 10.114795 | 10.193291 | 9 |
| 52 | 9.806860 | 252 | 9.885100 | 176 | 9.921760 | 428 | 10.078240 | 10.114900 | 10.193140 | 8 |
| 53 | 9.807011 | 252 | 9.884994 | 176 | 9.922017 | 428 | 10.077983 | 10.115006 | 10.192989 | 7 |
| 54 | 9.807163 | 252 | 9.884889 | 176 | 9.922274 | 428 | 10.077726 | 10.115111 | 10.192837 | 6 |
| 55 | 9.807314 | 252 | 9.884783 | 176 | 9.922530 | 428 | 10.077470 | 10.115217 | 10.192686 | 5 |
| 56 | 9.807465 | 251 | 9.884677 | 176 | 9.922787 | 428 | 10.077213 | 10.115323 | 10.192535 | 4 |
| 57 | 9.807615 | 251 | 9.884572 | 176 | 9.923044 | 428 | 10.076956 | 10.115428 | 10.192385 | 3 |
| 58 | 9.807766 | 251 | 9.884466 | 176 | 9.923300 | 428 | 10.076700 | 10.115534 | 10.192234 | 2 |
| 59 | 9.807917 | 251 | 9.884360 | 176 | 9.923557 | 428 | 10.076443 | 10.115640 | 10.192083 | 1 |
| 60 | 9.808067 | | 9.884254 | | 9.923813 | | 10.076187 | 10.115746 | 10.191933 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

### 50 Degrees.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

40 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.808067 | 251 | 9.884254 | 177 | 9.923813 | 428 | 10.076187 | 10.115746 | 10.191933 | 60 |
| 1 | 9.808218 | 251 | 9.884148 | 177 | 9.924070 | 428 | 10.075930 | 10.115852 | 10.191782 | 59 |
| 2 | 9.808368 | 251 | 9.884042 | 177 | 9.924327 | 428 | 10.075673 | 10.115958 | 10.191632 | 58 |
| 3 | 9.808519 | 250 | 9.883936 | 177 | 9.924583 | 427 | 10.075417 | 10.116064 | 10.191481 | 57 |
| 4 | 9.808669 | 250 | 9.883829 | 177 | 9.924840 | 427 | 10.075160 | 10.116171 | 10.191331 | 56 |
| 5 | 9.808819 | 250 | 9.883723 | 177 | 9.925096 | 427 | 10.074904 | 10.116277 | 10.191181 | 55 |
| 6 | 9.808969 | 250 | 9.883617 | 177 | 9.925352 | 427 | 10.074648 | 10.116383 | 10.191031 | 54 |
| 7 | 9.809119 | 250 | 9.883510 | 177 | 9.925609 | 427 | 10.074391 | 10.116490 | 10.190881 | 53 |
| 8 | 9.809269 | 250 | 9.883404 | 177 | 9.925865 | 427 | 10.074135 | 10.116596 | 10.190731 | 52 |
| 9 | 9.809419 | 249 | 9.883297 | 178 | 9.926122 | 427 | 10.073878 | 10.116703 | 10.190581 | 51 |
| 10 | 9.809569 | 249 | 9.883191 | 178 | 9.926378 | 427 | 10.073622 | 10.116809 | 10.190431 | 50 |
| 11 | 9.809718 | 249 | 9.883084 | 178 | 9.926634 | 427 | 10.073366 | 10.116916 | 10.190282 | 49 |
| 12 | 9.809868 | 249 | 9.882977 | 178 | 9.926890 | 427 | 10.073110 | 10.117023 | 10.190132 | 48 |
| 13 | 9.810017 | 249 | 9.882871 | 178 | 9.927147 | 427 | 10.072853 | 10.117129 | 10.189983 | 47 |
| 14 | 9.810167 | 249 | 9.882764 | 178 | 9.927403 | 427 | 10.072597 | 10.117236 | 10.189833 | 46 |
| 15 | 9.810316 | 248 | 9.882657 | 178 | 9.927659 | 427 | 10.072341 | 10.117343 | 10.189684 | 45 |
| 16 | 9.810465 | 248 | 9.882550 | 178 | 9.927915 | 427 | 10.072085 | 10.117450 | 10.189535 | 44 |
| 17 | 9.810614 | 248 | 9.882443 | 178 | 9.928171 | 427 | 10.071829 | 10.117557 | 10.189386 | 43 |
| 18 | 9.810763 | 248 | 9.882336 | 179 | 9.928427 | 427 | 10.071573 | 10.117664 | 10.189237 | 42 |
| 19 | 9.810912 | 248 | 9.882229 | 179 | 9.928683 | 427 | 10.071317 | 10.117771 | 10.189088 | 41 |
| 20 | 9.811061 | 248 | 9.882121 | 179 | 9.928940 | 427 | 10.071060 | 10.117879 | 10.188939 | 40 |
| 21 | 9.811210 | 248 | 9.882014 | 179 | 9.929196 | 427 | 10.070804 | 10.117986 | 10.188790 | 39 |
| 22 | 9.811358 | 247 | 9.881907 | 179 | 9.929452 | 427 | 10.070548 | 10.118093 | 10.188642 | 38 |
| 23 | 9.811507 | 247 | 9.881799 | 179 | 9.929708 | 427 | 10.070292 | 10.118201 | 10.188493 | 37 |
| 24 | 9.811655 | 247 | 9.881692 | 179 | 9.929964 | 427 | 10.070036 | 10.118308 | 10.188345 | 36 |
| 25 | 9.811804 | 247 | 9.881584 | 179 | 9.930220 | 427 | 10.069780 | 10.118416 | 10.188196 | 35 |
| 26 | 9.811952 | 247 | 9.881477 | 179 | 9.930475 | 427 | 10.069525 | 10.118523 | 10.188048 | 34 |
| 27 | 9.812100 | 247 | 9.881369 | 179 | 9.930731 | 426 | 10.069269 | 10.118631 | 10.187900 | 33 |
| 28 | 9.812248 | 247 | 9.881261 | 180 | 9.930987 | 426 | 10.069013 | 10.118739 | 10.187752 | 32 |
| 29 | 9.812396 | 246 | 9.881153 | 180 | 9.931243 | 426 | 10.068757 | 10.118847 | 10.187604 | 31 |
| 30 | 9.812544 | 246 | 9.881046 | 180 | 9.931499 | 426 | 10.068501 | 10.118954 | 10.187456 | 30 |
| 31 | 9.812692 | 246 | 9.880938 | 180 | 9.931755 | 426 | 10.068245 | 10.119062 | 10.187308 | 29 |
| 32 | 9.812840 | 246 | 9.880830 | 180 | 9.932010 | 426 | 10.067990 | 10.119170 | 10.187160 | 28 |
| 33 | 9.812988 | 246 | 9.880722 | 180 | 9.932266 | 426 | 10.067734 | 10.119278 | 10.187012 | 27 |
| 34 | 9.813135 | 246 | 9.880613 | 180 | 9.932522 | 426 | 10.067478 | 10.119387 | 10.186865 | 26 |
| 35 | 9.813283 | 246 | 9.880505 | 180 | 9.932778 | 426 | 10.067222 | 10.119495 | 10.186717 | 25 |
| 36 | 9.813430 | 245 | 9.880397 | 180 | 9.933033 | 426 | 10.066967 | 10.119603 | 10.186570 | 24 |
| 37 | 9.813578 | 245 | 9.880289 | 181 | 9.933289 | 426 | 10.066711 | 10.119711 | 10.186422 | 23 |
| 38 | 9.813725 | 245 | 9.880180 | 181 | 9.933545 | 426 | 10.066455 | 10.119820 | 10.186275 | 22 |
| 39 | 9.813872 | 245 | 9.880072 | 181 | 9.933800 | 426 | 10.066200 | 10.119928 | 10.186128 | 21 |
| 40 | 9.814019 | 245 | 9.879963 | 181 | 9.934056 | 426 | 10.065944 | 10.120037 | 10.185981 | 20 |
| 41 | 9.814166 | 245 | 9.879855 | 181 | 9.934311 | 426 | 10.065689 | 10.120145 | 10.185834 | 19 |
| 42 | 9.814313 | 245 | 9.879746 | 181 | 9.934567 | 426 | 10.065433 | 10.120254 | 10.185687 | 18 |
| 43 | 9.814460 | 244 | 9.879637 | 181 | 9.934823 | 426 | 10.065177 | 10.120363 | 10.185540 | 17 |
| 44 | 9.814607 | 244 | 9.879529 | 181 | 9.935078 | 426 | 10.064922 | 10.120471 | 10.185393 | 16 |
| 45 | 9.814753 | 244 | 9.879420 | 181 | 9.935333 | 426 | 10.064667 | 10.120580 | 10.185247 | 15 |
| 46 | 9.814900 | 244 | 9.879311 | 181 | 9.935589 | 426 | 10.064411 | 10.120689 | 10.185100 | 14 |
| 47 | 9.815046 | 244 | 9.879202 | 182 | 9.935844 | 426 | 10.064156 | 10.120798 | 10.184954 | 13 |
| 48 | 9.815193 | 244 | 9.879093 | 182 | 9.936100 | 426 | 10.063900 | 10.120907 | 10.184807 | 12 |
| 49 | 9.815339 | 244 | 9.878984 | 182 | 9.936355 | 426 | 10.063645 | 10.121016 | 10.184661 | 11 |
| 50 | 9.815485 | 243 | 9.878875 | 182 | 9.936610 | 426 | 10.063390 | 10.121125 | 10.184515 | 10 |
| 51 | 9.815632 | 243 | 9.878766 | 182 | 9.936866 | 426 | 10.063134 | 10.121234 | 10.184368 | 9 |
| 52 | 9.815778 | 243 | 9.878656 | 182 | 9.937121 | 426 | 10.062879 | 10.121344 | 10.184222 | 8 |
| 53 | 9.815924 | 243 | 9.878547 | 182 | 9.937376 | 425 | 10.062624 | 10.121453 | 10.184076 | 7 |
| 54 | 9.816069 | 243 | 9.878438 | 182 | 9.937632 | 425 | 10.062368 | 10.121562 | 10.183931 | 6 |
| 55 | 9.816215 | 243 | 9.878328 | 182 | 9.937887 | 425 | 10.062113 | 10.121672 | 10.183785 | 5 |
| 56 | 9.816361 | 243 | 9.878219 | 183 | 9.938142 | 425 | 10.061858 | 10.121781 | 10.183639 | 4 |
| 57 | 9.816507 | 242 | 9.878109 | 183 | 9.938398 | 425 | 10.061602 | 10.121891 | 10.183493 | 3 |
| 58 | 9.816652 | 242 | 9.877999 | 183 | 9.938653 | 425 | 10.061347 | 10.122001 | 10.183348 | 2 |
| 59 | 9.816798 | 242 | 9.877890 | 183 | 9.938908 | 425 | 10.061092 | 10.122110 | 10.183202 | 1 |
| 60 | 9.816943 | | 9.877780 | | 9.939163 | | 10.060837 | 10.122220 | 10.183057 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

49 Degrees.

41 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.816943 | 242 | 9.877780 | 183 | 9.939163 | 425 | 10.060837 | 10.122220 | 10.183057 | 60 |
| 1 | 9.817088 | 242 | 9.877670 | 183 | 9.939418 | 425 | 10.060582 | 10.122330 | 10.182912 | 59 |
| 2 | 9.817233 | 242 | 9.877560 | 183 | 9.939673 | 425 | 10.060327 | 10.122440 | 10.182767 | 58 |
| 3 | 9.817379 | 242 | 9.877450 | 183 | 9.939928 | 425 | 10.060072 | 10.122550 | 10.182621 | 57 |
| 4 | 9.817524 | 241 | 9.877340 | 183 | 9.940183 | 425 | 10.059817 | 10.122660 | 10.182476 | 56 |
| 5 | 9.817668 | 241 | 9.877230 | 184 | 9.940438 | 425 | 10.059562 | 10.122770 | 10.182332 | 55 |
| 6 | 9.817813 | 241 | 9.877120 | 184 | 9.940694 | 425 | 10.059306 | 10.122880 | 10.182187 | 54 |
| 7 | 9.817958 | 241 | 9.877010 | 184 | 9.940949 | 425 | 10.059051 | 10.122990 | 10.182042 | 53 |
| 8 | 9.818103 | 241 | 9.876899 | 184 | 9.941204 | 425 | 10.058796 | 10.123101 | 10.181897 | 52 |
| 9 | 9.818247 | 241 | 9.876789 | 184 | 9.941458 | 425 | 10.058542 | 10.123211 | 10.181753 | 51 |
| 10 | 9.818392 | 241 | 9.876678 | 184 | 9.941714 | 425 | 10.058286 | 10.123322 | 10.181608 | 50 |
| 11 | 9.818536 | 240 | 9.876568 | 184 | 9.941968 | 425 | 10.058032 | 10.123432 | 10.181464 | 49 |
| 12 | 9.818681 | 240 | 9.876457 | 184 | 9.942223 | 425 | 10.057777 | 10.123543 | 10.181319 | 48 |
| 13 | 9.818825 | 240 | 9.876347 | 184 | 9.942478 | 425 | 10.057522 | 10.123653 | 10.181175 | 47 |
| 14 | 9.818969 | 240 | 9.876236 | 185 | 9.942733 | 425 | 10.057267 | 10.123764 | 10.181031 | 46 |
| 15 | 9.819113 | 240 | 9.876125 | 185 | 9.942988 | 425 | 10.057012 | 10.123875 | 10.180887 | 45 |
| 16 | 9.819257 | 240 | 9.876014 | 185 | 9.943243 | 425 | 10.056757 | 10.123986 | 10.180743 | 44 |
| 17 | 9.819401 | 240 | 9.875904 | 185 | 9.943498 | 425 | 10.056502 | 10.124096 | 10.180599 | 43 |
| 18 | 9.819545 | 239 | 9.875793 | 185 | 9.943752 | 425 | 10.056248 | 10.124207 | 10.180455 | 42 |
| 19 | 9.819689 | 239 | 9.875682 | 185 | 9.944007 | 425 | 10.055993 | 10.124318 | 10.180311 | 41 |
| 20 | 9.819832 | 239 | 9.875571 | 185 | 9.944262 | 425 | 10.055738 | 10.124429 | 10.180168 | 40 |
| 21 | 9.819976 | 239 | 9.875459 | 185 | 9.944517 | 425 | 10.055483 | 10.124541 | 10.180024 | 39 |
| 22 | 9.820120 | 239 | 9.875348 | 185 | 9.944771 | 425 | 10.055229 | 10.124652 | 10.179880 | 38 |
| 23 | 9.820263 | 239 | 9.875237 | 185 | 9.945026 | 425 | 10.054974 | 10.124763 | 10.179737 | 37 |
| 24 | 9.820406 | 239 | 9.875126 | 186 | 9.945281 | 425 | 10.054719 | 10.124874 | 10.179594 | 36 |
| 25 | 9.820550 | 238 | 9.875014 | 186 | 9.945535 | 425 | 10.054465 | 10.124986 | 10.179450 | 35 |
| 26 | 9.820693 | 238 | 9.874903 | 186 | 9.945790 | 425 | 10.054210 | 10.125097 | 10.179307 | 34 |
| 27 | 9.820836 | 238 | 9.874791 | 186 | 9.946045 | 425 | 10.053955 | 10.125209 | 10.179164 | 33 |
| 28 | 9.820979 | 238 | 9.874680 | 186 | 9.946299 | 425 | 10.053701 | 10.125320 | 10.179021 | 32 |
| 29 | 9.821122 | 238 | 9.874568 | 186 | 9.946554 | 425 | 10.053446 | 10.125432 | 10.178878 | 31 |
| 30 | 9.821265 | 238 | 9.874456 | 186 | 9.946808 | 425 | 10.053192 | 10.125544 | 10.178735 | 30 |
| 31 | 9.821407 | 238 | 9.874344 | 186 | 9.947063 | 424 | 10.052937 | 10.125656 | 10.178593 | 29 |
| 32 | 9.821550 | 238 | 9.874232 | 186 | 9.947318 | 424 | 10.052682 | 10.125768 | 10.178450 | 28 |
| 33 | 9.821693 | 237 | 9.874121 | 187 | 9.947572 | 424 | 10.052428 | 10.125879 | 10.178307 | 27 |
| 34 | 9.821835 | 237 | 9.874009 | 187 | 9.947826 | 424 | 10.052174 | 10.125991 | 10.178165 | 26 |
| 35 | 9.821977 | 237 | 9.873896 | 187 | 9.948081 | 424 | 10.051919 | 10.126104 | 10.178023 | 25 |
| 36 | 9.822120 | 237 | 9.873784 | 187 | 9.948336 | 424 | 10.051664 | 10.126216 | 10.177880 | 24 |
| 37 | 9.822262 | 237 | 9.873672 | 187 | 9.948590 | 424 | 10.051410 | 10.126328 | 10.177738 | 23 |
| 38 | 9.822404 | 237 | 9.873560 | 187 | 9.948844 | 424 | 10.051156 | 10.126440 | 10.177596 | 22 |
| 39 | 9.822546 | 237 | 9.873448 | 187 | 9.949099 | 424 | 10.050901 | 10.126552 | 10.177454 | 21 |
| 40 | 9.822688 | 237 | 9.873335 | 187 | 9.949353 | 424 | 10.050647 | 10.126665 | 10.177312 | 20 |
| 41 | 9.822830 | 236 | 9.873223 | 187 | 9.949607 | 424 | 10.050393 | 10.126777 | 10.177170 | 19 |
| 42 | 9.822972 | 236 | 9.873110 | 188 | 9.949862 | 424 | 10.050138 | 10.126890 | 10.177028 | 18 |
| 43 | 9.823114 | 236 | 9.872998 | 188 | 9.950116 | 424 | 10.049884 | 10.127002 | 10.176886 | 17 |
| 44 | 9.823255 | 236 | 9.872885 | 188 | 9.950370 | 424 | 10.049630 | 10.127115 | 10.176745 | 16 |
| 45 | 9.823397 | 236 | 9.872772 | 188 | 9.950625 | 424 | 10.049375 | 10.127228 | 10.176603 | 15 |
| 46 | 9.823539 | 236 | 9.872659 | 188 | 9.950879 | 424 | 10.049121 | 10.127341 | 10.176461 | 14 |
| 47 | 9.823680 | 235 | 9.872547 | 188 | 9.951133 | 424 | 10.048867 | 10.127453 | 10.176320 | 13 |
| 48 | 9.823821 | 235 | 9.872434 | 188 | 9.951388 | 424 | 10.048612 | 10.127566 | 10.176179 | 12 |
| 49 | 9.823963 | 235 | 9.872321 | 188 | 9.951642 | 424 | 10.048358 | 10.127679 | 10.176037 | 11 |
| 50 | 9.824104 | 235 | 9.872208 | 188 | 9.951896 | 424 | 10.048104 | 10.127792 | 10.175896 | 10 |
| 51 | 9.824245 | 235 | 9.872095 | 189 | 9.952150 | 424 | 10.047850 | 10.127905 | 10.175755 | 9 |
| 52 | 9.824386 | 235 | 9.871981 | 189 | 9.952405 | 424 | 10.047595 | 10.128019 | 10.175614 | 8 |
| 53 | 9.824527 | 235 | 9.871868 | 189 | 9.952659 | 424 | 10.047341 | 10.128132 | 10.175473 | 7 |
| 54 | 9.824668 | 234 | 9.871755 | 189 | 9.952913 | 424 | 10.047087 | 10.128245 | 10.175332 | 6 |
| 55 | 9.824808 | 234 | 9.871641 | 189 | 9.953167 | 423 | 10.046833 | 10.128359 | 10.175192 | 5 |
| 56 | 9.824949 | 234 | 9.871528 | 189 | 9.953421 | 423 | 10.046579 | 10.128472 | 10.175051 | 4 |
| 57 | 9.825090 | 234 | 9.871414 | 189 | 9.953675 | 423 | 10.046325 | 10.128586 | 10.174910 | 3 |
| 58 | 9.825230 | 234 | 9.871301 | 189 | 9.953929 | 423 | 10.046071 | 10.128699 | 10.174770 | 2 |
| 59 | 9.825371 | 234 | 9.871187 | 189 | 9.954183 | 423 | 10.045817 | 10.128813 | 10.174629 | 1 |
| 60 | 9.825511 | | 9.871073 | | 9.954437 | | 10.045563 | 10.128927 | 10.174489 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

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## 42 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.825511 | 234 | 9.871073 | 190 | 9.954437 | 423 | 10.045563 | 10.128927 | 10.174489 | 60 |
| 1 | 9.825651 | 233 | 9.870960 | 190 | 9.954691 | 423 | 10.045309 | 10.129040 | 10.174349 | 59 |
| 2 | 9.825791 | 233 | 9.870846 | 190 | 9.954945 | 423 | 10.045055 | 10.129154 | 10.174209 | 58 |
| 3 | 9.825931 | 233 | 9.870732 | 190 | 9.955200 | 423 | 10.044800 | 10.129268 | 10.174069 | 57 |
| 4 | 9.826071 | 233 | 9.870618 | 190 | 9.955454 | 423 | 10.044546 | 10.129382 | 10.173929 | 56 |
| 5 | 9.826211 | 233 | 9.870504 | 190 | 9.955707 | 423 | 10.044293 | 10.129496 | 10.173789 | 55 |
| 6 | 9.826351 | 233 | 9.870390 | 190 | 9.955961 | 423 | 10.044039 | 10.129610 | 10.173649 | 54 |
| 7 | 9.826491 | 233 | 9.870276 | 190 | 9.956215 | 423 | 10.043785 | 10.129724 | 10.173509 | 53 |
| 8 | 9.826631 | 233 | 9.870161 | 190 | 9.956469 | 423 | 10.043531 | 10.129839 | 10.173369 | 52 |
| 9 | 9.826770 | 232 | 9.870047 | 191 | 9.956723 | 423 | 10.043277 | 10.129953 | 10.173230 | 51 |
| 10 | 9.826910 | 232 | 9.869933 | 191 | 9.956977 | 423 | 10.043023 | 10.130067 | 10.173090 | 50 |
| 11 | 9.827049 | 232 | 9.869818 | 191 | 9.957231 | 423 | 10.042769 | 10.130182 | 10.172951 | 49 |
| 12 | 9.827189 | 232 | 9.869704 | 191 | 9.957485 | 423 | 10.042515 | 10.130296 | 10.172811 | 48 |
| 13 | 9.827328 | 232 | 9.869589 | 191 | 9.957739 | 423 | 10.042261 | 10.130411 | 10.172672 | 47 |
| 14 | 9.827467 | 232 | 9.869474 | 191 | 9.957993 | 423 | 10.042007 | 10.130526 | 10.172533 | 46 |
| 15 | 9.827606 | 232 | 9.869360 | 191 | 9.958246 | 423 | 10.041754 | 10.130640 | 10.172394 | 45 |
| 16 | 9.827745 | 232 | 9.869245 | 191 | 9.958500 | 423 | 10.041500 | 10.130755 | 10.172255 | 44 |
| 17 | 9.827884 | 231 | 9.869130 | 191 | 9.958754 | 423 | 10.041246 | 10.130870 | 10.172116 | 43 |
| 18 | 9.828023 | 231 | 9.869015 | 192 | 9.959008 | 423 | 10.040992 | 10.130985 | 10.171977 | 42 |
| 19 | 9.828162 | 231 | 9.868900 | 192 | 9.959262 | 423 | 10.040738 | 10.131100 | 10.171838 | 41 |
| 20 | 9.828301 | 231 | 9.868785 | 192 | 9.959516 | 423 | 10.040484 | 10.131215 | 10.171699 | 40 |
| 21 | 9.828439 | 231 | 9.868670 | 192 | 9.959769 | 423 | 10.040231 | 10.131330 | 10.171561 | 39 |
| 22 | 9.828578 | 231 | 9.868555 | 192 | 9.960023 | 423 | 10.039977 | 10.131445 | 10.171422 | 38 |
| 23 | 9.828716 | 231 | 9.868440 | 192 | 9.960277 | 423 | 10.039723 | 10.131560 | 10.171284 | 37 |
| 24 | 9.828855 | 230 | 9.868324 | 192 | 9.960531 | 423 | 10.039469 | 10.131676 | 10.171145 | 36 |
| 25 | 9.828993 | 230 | 9.868209 | 192 | 9.960784 | 423 | 10.039216 | 10.131791 | 10.171007 | 35 |
| 26 | 9.829131 | 230 | 9.868093 | 192 | 9.961038 | 423 | 10.038962 | 10.131907 | 10.170869 | 34 |
| 27 | 9.829269 | 230 | 9.867978 | 193 | 9.961291 | 423 | 10.038709 | 10.132022 | 10.170731 | 33 |
| 28 | 9.829407 | 230 | 9.867862 | 193 | 9.961545 | 423 | 10.038455 | 10.132138 | 10.170593 | 32 |
| 29 | 9.829545 | 230 | 9.867747 | 193 | 9.961799 | 423 | 10.038201 | 10.132253 | 10.170455 | 31 |
| 30 | 9.829683 | 230 | 9.867631 | 193 | 9.962052 | 423 | 10.037948 | 10.132369 | 10.170317 | 30 |
| 31 | 9.829821 | 229 | 9.867515 | 193 | 9.962306 | 423 | 10.037694 | 10.132485 | 10.170179 | 29 |
| 32 | 9.829959 | 229 | 9.867399 | 193 | 9.962560 | 423 | 10.037440 | 10.132601 | 10.170041 | 28 |
| 33 | 9.830097 | 229 | 9.867283 | 193 | 9.962813 | 423 | 10.037187 | 10.132717 | 10.169903 | 27 |
| 34 | 9.830234 | 229 | 9.867167 | 193 | 9.963067 | 423 | 10.036933 | 10.132833 | 10.169766 | 26 |
| 35 | 9.830372 | 229 | 9.867051 | 193 | 9.963320 | 423 | 10.036680 | 10.132949 | 10.169628 | 25 |
| 36 | 9.830509 | 229 | 9.866935 | 194 | 9.963574 | 423 | 10.036426 | 10.133065 | 10.169491 | 24 |
| 37 | 9.830646 | 229 | 9.866819 | 194 | 9.963827 | 423 | 10.036173 | 10.133181 | 10.169354 | 23 |
| 38 | 9.830784 | 229 | 9.866703 | 194 | 9.964081 | 423 | 10.035919 | 10.133297 | 10.169216 | 22 |
| 39 | 9.830921 | 228 | 9.866586 | 194 | 9.964335 | 423 | 10.035665 | 10.133414 | 10.169079 | 21 |
| 40 | 9.831058 | 228 | 9.866470 | 194 | 9.964588 | 423 | 10.035412 | 10.133530 | 10.168942 | 20 |
| 41 | 9.831195 | 228 | 9.866353 | 194 | 9.964842 | 422 | 10.035158 | 10.133647 | 10.168805 | 19 |
| 42 | 9.831332 | 228 | 9.866237 | 194 | 9.965095 | 422 | 10.034905 | 10.133763 | 10.168668 | 18 |
| 43 | 9.831469 | 228 | 9.866120 | 194 | 9.965349 | 422 | 10.034651 | 10.133880 | 10.168531 | 17 |
| 44 | 9.831606 | 228 | 9.866004 | 195 | 9.965602 | 422 | 10.034398 | 10.133996 | 10.168394 | 16 |
| 45 | 9.831742 | 228 | 9.865887 | 195 | 9.965855 | 422 | 10.034145 | 10.134113 | 10.168258 | 15 |
| 46 | 9.831879 | 228 | 9.865770 | 195 | 9.966109 | 422 | 10.033891 | 10.134230 | 10.168121 | 14 |
| 47 | 9.832015 | 227 | 9.865653 | 195 | 9.966362 | 422 | 10.033638 | 10.134347 | 10.167985 | 13 |
| 48 | 9.832152 | 227 | 9.865536 | 195 | 9.966616 | 422 | 10.033384 | 10.134464 | 10.167848 | 12 |
| 49 | 9.832288 | 227 | 9.865419 | 195 | 9.966869 | 422 | 10.033131 | 10.134581 | 10.167712 | 11 |
| 50 | 9.832425 | 227 | 9.865302 | 195 | 9.967123 | 422 | 10.032877 | 10.134698 | 10.167575 | 10 |
| 51 | 9.832561 | 227 | 9.865185 | 195 | 9.967376 | 422 | 10.032624 | 10.134815 | 10.167439 | 9 |
| 52 | 9.832697 | 227 | 9.865068 | 195 | 9.967629 | 422 | 10.032371 | 10.134932 | 10.167303 | 8 |
| 53 | 9.832833 | 227 | 9.864950 | 195 | 9.967883 | 422 | 10.032117 | 10.135050 | 10.167167 | 7 |
| 54 | 9.832969 | 226 | 9.864833 | 196 | 9.968136 | 422 | 10.031864 | 10.135167 | 10.167031 | 6 |
| 55 | 9.833105 | 226 | 9.864716 | 196 | 9.968389 | 422 | 10.031611 | 10.135284 | 10.166895 | 5 |
| 56 | 9.833241 | 226 | 9.864598 | 196 | 9.968643 | 422 | 10.031357 | 10.135402 | 10.166759 | 4 |
| 57 | 9.833377 | 226 | 9.864481 | 196 | 9.968896 | 422 | 10.031104 | 10.135519 | 10.166623 | 3 |
| 58 | 9.833512 | 226 | 9.864363 | 196 | 9.969149 | 422 | 10.030851 | 10.135637 | 10.166488 | 2 |
| 59 | 9.833648 | 226 | 9.864245 | 196 | 9.969403 | 422 | 10.030597 | 10.135755 | 10.166352 | 1 |
| 60 | 9.833783 | 226 | 9.864127 | 196 | 9.969656 | 422 | 10.030344 | 10.135873 | 10.166217 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 47 Degrees.

## 43 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.833783 | 226 | 9.864127 | 196 | 9.969656 | 422 | 10.030344 | 10.135873 | 10.166217 | 60 |
| 1 | 9.833919 | 225 | 9.864010 | 196 | 9.969909 | 422 | 10.030091 | 10.135990 | 10.166081 | 59 |
| 2 | 9.834054 | 225 | 9.863892 | 197 | 9.970162 | 422 | 10.029838 | 10.136108 | 10.165946 | 58 |
| 3 | 9.834189 | 225 | 9.863774 | 197 | 9.970416 | 422 | 10.029584 | 10.136226 | 10.165811 | 57 |
| 4 | 9.834325 | 225 | 9.863656 | 197 | 9.970669 | 422 | 10.029331 | 10.136344 | 10.165675 | 56 |
| 5 | 9.834460 | 225 | 9.863538 | 197 | 9.970922 | 422 | 10.029078 | 10.136462 | 10.165540 | 55 |
| 6 | 9.834595 | 225 | 9.863419 | 197 | 9.971175 | 422 | 10.028825 | 10.136581 | 10.165405 | 54 |
| 7 | 9.834730 | 225 | 9.863301 | 197 | 9.971429 | 422 | 10.028571 | 10.136699 | 10.165270 | 53 |
| 8 | 9.834865 | 225 | 9.863183 | 197 | 9.971682 | 422 | 10.028318 | 10.136817 | 10.165135 | 52 |
| 9 | 9.834999 | 224 | 9.863064 | 197 | 9.971935 | 422 | 10.028065 | 10.136936 | 10.165001 | 51 |
| 10 | 9.835134 | 224 | 9.862946 | 198 | 9.972188 | 422 | 10.027812 | 10.137054 | 10.164866 | 50 |
| 11 | 9.835269 | 224 | 9.862827 | 198 | 9.972441 | 422 | 10.027559 | 10.137173 | 10.164731 | 49 |
| 12 | 9.835403 | 224 | 9.862709 | 198 | 9.972694 | 422 | 10.027306 | 10.137291 | 10.164597 | 48 |
| 13 | 9.835538 | 224 | 9.862590 | 198 | 9.972948 | 422 | 10.027052 | 10.137410 | 10.164462 | 47 |
| 14 | 9.835672 | 224 | 9.862471 | 198 | 9.973201 | 422 | 10.026799 | 10.137529 | 10.164328 | 46 |
| 15 | 9.835807 | 224 | 9.862353 | 198 | 9.973454 | 422 | 10.026546 | 10.137647 | 10.164193 | 45 |
| 16 | 9.835941 | 224 | 9.862234 | 198 | 9.973707 | 422 | 10.026293 | 10.137766 | 10.164059 | 44 |
| 17 | 9.836075 | 223 | 9.862115 | 198 | 9.973960 | 422 | 10.026040 | 10.137885 | 10.163925 | 43 |
| 18 | 9.836209 | 223 | 9.861996 | 198 | 9.974213 | 422 | 10.025787 | 10.138004 | 10.163791 | 42 |
| 19 | 9.836343 | 223 | 9.861877 | 198 | 9.974466 | 422 | 10.025534 | 10.138123 | 10.163657 | 41 |
| 20 | 9.836477 | 223 | 9.861758 | 199 | 9.974719 | 422 | 10.025281 | 10.138242 | 10.163523 | 40 |
| 21 | 9.836611 | 223 | 9.861638 | 199 | 9.974973 | 422 | 10.025027 | 10.138362 | 10.163389 | 39 |
| 22 | 9.836745 | 223 | 9.861519 | 199 | 9.975226 | 422 | 10.024774 | 10.138481 | 10.163255 | 38 |
| 23 | 9.836878 | 223 | 9.861400 | 199 | 9.975479 | 422 | 10.024521 | 10.138600 | 10.163122 | 37 |
| 24 | 9.837012 | 222 | 9.861280 | 199 | 9.975732 | 422 | 10.024268 | 10.138720 | 10.162988 | 36 |
| 25 | 9.837146 | 222 | 9.861161 | 199 | 9.975985 | 422 | 10.024015 | 10.138839 | 10.162854 | 35 |
| 26 | 9.837279 | 222 | 9.861041 | 199 | 9.976238 | 422 | 10.023762 | 10.138959 | 10.162721 | 34 |
| 27 | 9.837412 | 222 | 9.860922 | 199 | 9.976491 | 422 | 10.023509 | 10.139078 | 10.162588 | 33 |
| 28 | 9.837546 | 222 | 9.860802 | 199 | 9.976744 | 422 | 10.023256 | 10.139198 | 10.162454 | 32 |
| 29 | 9.837679 | 222 | 9.860682 | 199 | 9.976997 | 422 | 10.023003 | 10.139318 | 10.162321 | 31 |
| 30 | 9.837812 | 222 | 9.860562 | 200 | 9.977250 | 422 | 10.022750 | 10.139438 | 10.162188 | 30 |
| 31 | 9.837945 | 222 | 9.860442 | 200 | 9.977503 | 422 | 10.022497 | 10.139558 | 10.162055 | 29 |
| 32 | 9.838078 | 221 | 9.860322 | 200 | 9.977756 | 422 | 10.022244 | 10.139678 | 10.161922 | 28 |
| 33 | 9.838211 | 221 | 9.860202 | 200 | 9.978009 | 422 | 10.021991 | 10.139798 | 10.161789 | 27 |
| 34 | 9.838344 | 221 | 9.860082 | 200 | 9.978262 | 422 | 10.021738 | 10.139918 | 10.161656 | 26 |
| 35 | 9.838477 | 221 | 9.859962 | 200 | 9.978515 | 422 | 10.021485 | 10.140038 | 10.161523 | 25 |
| 36 | 9.838610 | 221 | 9.859842 | 200 | 9.978768 | 422 | 10.021232 | 10.140158 | 10.161390 | 24 |
| 37 | 9.838742 | 221 | 9.859721 | 200 | 9.979021 | 422 | 10.020979 | 10.140279 | 10.161258 | 23 |
| 38 | 9.838875 | 221 | 9.859601 | 201 | 9.979274 | 422 | 10.020726 | 10.140399 | 10.161125 | 22 |
| 39 | 9.839007 | 221 | 9.859480 | 201 | 9.979527 | 422 | 10.020473 | 10.140520 | 10.160993 | 21 |
| 40 | 9.839140 | 220 | 9.859360 | 201 | 9.979780 | 422 | 10.020220 | 10.140640 | 10.160860 | 20 |
| 41 | 9.839272 | 220 | 9.859239 | 201 | 9.980033 | 422 | 10.019967 | 10.140761 | 10.160728 | 19 |
| 42 | 9.839404 | 220 | 9.859119 | 201 | 9.980286 | 422 | 10.019714 | 10.140881 | 10.160596 | 18 |
| 43 | 9.839536 | 220 | 9.858998 | 201 | 9.980538 | 422 | 10.019462 | 10.141002 | 10.160464 | 17 |
| 44 | 9.839668 | 220 | 9.858877 | 201 | 9.980791 | 422 | 10.019209 | 10.141123 | 10.160332 | 16 |
| 45 | 9.839800 | 220 | 9.858756 | 201 | 9.981044 | 422 | 10.018956 | 10.141244 | 10.160200 | 15 |
| 46 | 9.839932 | 220 | 9.858635 | 202 | 9.981297 | 422 | 10.018703 | 10.141365 | 10.160068 | 14 |
| 47 | 9.840064 | 219 | 9.858514 | 202 | 9.981550 | 422 | 10.018450 | 10.141486 | 10.159936 | 13 |
| 48 | 9.840196 | 219 | 9.858393 | 202 | 9.981803 | 422 | 10.018197 | 10.141607 | 10.159804 | 12 |
| 49 | 9.840328 | 219 | 9.858272 | 202 | 9.982056 | 422 | 10.017944 | 10.141728 | 10.159672 | 11 |
| 50 | 9.840459 | 219 | 9.858151 | 202 | 9.982309 | 421 | 10.017691 | 10.141849 | 10.159541 | 10 |
| 51 | 9.840591 | 219 | 9.858029 | 202 | 9.982562 | 421 | 10.017438 | 10.141971 | 10.159409 | 9 |
| 52 | 9.840722 | 219 | 9.857908 | 202 | 9.982814 | 421 | 10.017186 | 10.142092 | 10.159278 | 8 |
| 53 | 9.840854 | 219 | 9.857786 | 202 | 9.983067 | 421 | 10.016933 | 10.142214 | 10.159146 | 7 |
| 54 | 9.840985 | 219 | 9.857665 | 203 | 9.983320 | 421 | 10.016680 | 10.142335 | 10.159015 | 6 |
| 55 | 9.841116 | 218 | 9.857543 | 203 | 9.983573 | 421 | 10.016427 | 10.142457 | 10.158884 | 5 |
| 56 | 9.841247 | 218 | 9.857422 | 203 | 9.983826 | 421 | 10.016174 | 10.142578 | 10.158753 | 4 |
| 57 | 9.841378 | 218 | 9.857300 | 203 | 9.984079 | 421 | 10.015921 | 10.142700 | 10.158622 | 3 |
| 58 | 9.841509 | 218 | 9.857178 | 203 | 9.984331 | 421 | 10.015669 | 10.142822 | 10.158491 | 2 |
| 59 | 9.841640 | 218 | 9.857056 | 203 | 9.984584 | 421 | 10.015416 | 10.142944 | 10.158360 | 1 |
| 60 | 9.841771 | 218 | 9.856934 | 203 | 9.984837 | 421 | 10.015163 | 10.143066 | 10.158229 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

## 46 Degrees.

# TABLE XXV.

## LOGARITHMIC SINES, TANGENTS, AND SECANTS.

### 44 Degrees.

| M | Sine. | Diff. | Co-sine. | D. | Tang. | Diff. | Co-tan. | Secant. | Co-sec. | M |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.841771 | 218 | 9.856934 | 203 | 9.984837 | 421 | 10.015163 | 10.143066 | 10.158229 | 60 |
| 1 | 9.841902 | 218 | 9.856812 | 203 | 9.985090 | 421 | 10.014910 | 10.143188 | 10.158098 | 59 |
| 2 | 9.842033 | 218 | 9.856690 | 204 | 9.985343 | 421 | 10.014657 | 10.143310 | 10.157967 | 58 |
| 3 | 9.842163 | 217 | 9.856568 | 204 | 9.985596 | 421 | 10.014404 | 10.143432 | 10.157837 | 57 |
| 4 | 9.842294 | 217 | 9.856446 | 204 | 9.985848 | 421 | 10.014152 | 10.143554 | 10.157706 | 56 |
| 5 | 9.842424 | 217 | 9.856323 | 204 | 9.986101 | 421 | 10.013899 | 10.143677 | 10.157576 | 55 |
| 6 | 9.842555 | 217 | 9.856201 | 204 | 9.986354 | 421 | 10.013646 | 10.143799 | 10.157445 | 54 |
| 7 | 9.842685 | 217 | 9.856078 | 204 | 9.986607 | 421 | 10.013393 | 10.143922 | 10.157315 | 53 |
| 8 | 9.842815 | 217 | 9.855956 | 204 | 9.986860 | 421 | 10.013140 | 10.144044 | 10.157185 | 52 |
| 9 | 9.842946 | 217 | 9.855833 | 204 | 9.987112 | 421 | 10.012888 | 10.144167 | 10.157054 | 51 |
| 10 | 9.843076 | 217 | 9.855711 | 205 | 9.987365 | 421 | 10.012635 | 10.144289 | 10.156924 | 50 |
| 11 | 9.843206 | 216 | 9.855588 | 205 | 9.987618 | 421 | 10.012382 | 10.144412 | 10.156794 | 49 |
| 12 | 9.843336 | 216 | 9.855465 | 205 | 9.987871 | 421 | 10.012129 | 10.144535 | 10.156664 | 48 |
| 13 | 9.843466 | 216 | 9.855342 | 205 | 9.988123 | 421 | 10.011877 | 10.144658 | 10.156534 | 47 |
| 14 | 9.843595 | 216 | 9.855219 | 205 | 9.988376 | 421 | 10.011624 | 10.144781 | 10.156405 | 46 |
| 15 | 9.843725 | 216 | 9.855096 | 205 | 9.988629 | 421 | 10.011371 | 10.144904 | 10.156275 | 45 |
| 16 | 9.843855 | 216 | 9.854973 | 205 | 9.988882 | 421 | 10.011118 | 10.145027 | 10.156145 | 44 |
| 17 | 9.843984 | 216 | 9.854850 | 205 | 9.989134 | 421 | 10.010866 | 10.145150 | 10.156016 | 43 |
| 18 | 9.844114 | 216 | 9.854727 | 206 | 9.989387 | 421 | 10.010613 | 10.145273 | 10.155886 | 42 |
| 19 | 9.844243 | 215 | 9.854603 | 206 | 9.989640 | 421 | 10.010360 | 10.145397 | 10.155757 | 41 |
| 20 | 9.844372 | 215 | 9.854480 | 206 | 9.989893 | 421 | 10.010107 | 10.145520 | 10.155628 | 40 |
| 21 | 9.844502 | 215 | 9.854356 | 206 | 9.990145 | 421 | 10.009855 | 10.145644 | 10.155498 | 39 |
| 22 | 9.844631 | 215 | 9.854233 | 206 | 9.990398 | 421 | 10.009602 | 10.145767 | 10.155369 | 38 |
| 23 | 9.844760 | 215 | 9.854109 | 206 | 9.990651 | 421 | 10.009349 | 10.145891 | 10.155240 | 37 |
| 24 | 9.844889 | 215 | 9.853986 | 206 | 9.990903 | 421 | 10.009097 | 10.146014 | 10.155111 | 36 |
| 25 | 9.845018 | 215 | 9.853862 | 206 | 9.991156 | 421 | 10.008844 | 10.146138 | 10.154982 | 35 |
| 26 | 9.845147 | 215 | 9.853738 | 206 | 9.991409 | 421 | 10.008591 | 10.146262 | 10.154853 | 34 |
| 27 | 9.845276 | 214 | 9.853614 | 206 | 9.991662 | 421 | 10.008338 | 10.146386 | 10.154724 | 33 |
| 28 | 9.845405 | 214 | 9.853490 | 207 | 9.991914 | 421 | 10.008086 | 10.146510 | 10.154595 | 32 |
| 29 | 9.845533 | 214 | 9.853366 | 207 | 9.992167 | 421 | 10.007833 | 10.146634 | 10.154467 | 31 |
| 30 | 9.845662 | 214 | 9.853242 | 207 | 9.992420 | 421 | 10.007580 | 10.146758 | 10.154338 | 30 |
| 31 | 9.845790 | 214 | 9.853118 | 207 | 9.992672 | 421 | 10.007328 | 10.146882 | 10.154210 | 29 |
| 32 | 9.845919 | 214 | 9.852994 | 207 | 9.992925 | 421 | 10.007075 | 10.147006 | 10.154081 | 28 |
| 33 | 9.846047 | 214 | 9.852869 | 207 | 9.993178 | 421 | 10.006822 | 10.147131 | 10.153953 | 27 |
| 34 | 9.846175 | 214 | 9.852745 | 207 | 9.993430 | 421 | 10.006570 | 10.147255 | 10.153825 | 26 |
| 35 | 9.846304 | 214 | 9.852620 | 207 | 9.993683 | 421 | 10.006317 | 10.147380 | 10.153696 | 25 |
| 36 | 9.846432 | 213 | 9.852496 | 208 | 9.993936 | 421 | 10.006064 | 10.147504 | 10.153568 | 24 |
| 37 | 9.846560 | 213 | 9.852371 | 208 | 9.994189 | 421 | 10.005811 | 10.147629 | 10.153440 | 23 |
| 38 | 9.846688 | 213 | 9.852247 | 208 | 9.994441 | 421 | 10.005559 | 10.147753 | 10.153312 | 22 |
| 39 | 9.846816 | 213 | 9.852122 | 208 | 9.994694 | 421 | 10.005306 | 10.147878 | 10.153184 | 21 |
| 40 | 9.846944 | 213 | 9.851997 | 208 | 9.994947 | 421 | 10.005053 | 10.148003 | 10.153056 | 20 |
| 41 | 9.847071 | 213 | 9.851872 | 208 | 9.995199 | 421 | 10.004801 | 10.148128 | 10.152929 | 19 |
| 42 | 9.847199 | 213 | 9.851747 | 208 | 9.995452 | 421 | 10.004548 | 10.148253 | 10.152801 | 18 |
| 43 | 9.847327 | 213 | 9.851622 | 208 | 9.995705 | 421 | 10.004295 | 10.148378 | 10.152673 | 17 |
| 44 | 9.847454 | 213 | 9.851497 | 208 | 9.995957 | 421 | 10.004043 | 10.148503 | 10.152546 | 16 |
| 45 | 9.847582 | 212 | 9.851372 | 209 | 9.996210 | 421 | 10.003790 | 10.148628 | 10.152418 | 15 |
| 46 | 9.847709 | 212 | 9.851246 | 209 | 9.996463 | 421 | 10.003537 | 10.148754 | 10.152291 | 14 |
| 47 | 9.847836 | 212 | 9.851121 | 209 | 9.996715 | 421 | 10.003285 | 10.148879 | 10.152164 | 13 |
| 48 | 9.847964 | 212 | 9.850996 | 209 | 9.996968 | 421 | 10.003032 | 10.149004 | 10.152036 | 12 |
| 49 | 9.848091 | 212 | 9.850870 | 209 | 9.997221 | 421 | 10.002779 | 10.149130 | 10.151909 | 11 |
| 50 | 9.848218 | 212 | 9.850745 | 209 | 9.997473 | 421 | 10.002527 | 10.149255 | 10.151782 | 10 |
| 51 | 9.848345 | 212 | 9.850619 | 209 | 9.997726 | 421 | 10.002274 | 10.149381 | 10.151655 | 9 |
| 52 | 9.848472 | 211 | 9.850493 | 209 | 9.997979 | 421 | 10.002021 | 10.149507 | 10.151528 | 8 |
| 53 | 9.848599 | 211 | 9.850368 | 210 | 9.998231 | 421 | 10.001769 | 10.149632 | 10.151401 | 7 |
| 54 | 9.848726 | 211 | 9.850242 | 210 | 9.998484 | 421 | 10.001516 | 10.149758 | 10.151274 | 6 |
| 55 | 9.848852 | 211 | 9.850116 | 210 | 9.998737 | 421 | 10.001263 | 10.149884 | 10.151148 | 5 |
| 56 | 9.848979 | 211 | 9.849990 | 210 | 9.998989 | 421 | 10.001011 | 10.150010 | 10.151021 | 4 |
| 57 | 9.849106 | 211 | 9.849864 | 210 | 9.999242 | 421 | 10.000758 | 10.150136 | 10.150894 | 3 |
| 58 | 9.849232 | 211 | 9.849738 | 210 | 9.999495 | 421 | 10.000505 | 10.150262 | 10.150768 | 2 |
| 59 | 9.849359 | 211 | 9.849611 | 210 | 9.999747 | 421 | 10.000253 | 10.150389 | 10.150641 | 1 |
| 60 | 9.849485 | | 9.849485 | | 0.000000 | | 10.000000 | 10.150515 | 10.150515 | 0 |
| M | Co-sine | | Sine. | | Co-tan. | | Tang. | Co-sec. | Secant. | M |

### 45 Degrees.

| M | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 000000 | 017452 | 034899 | 052336 | 069756 | 087156 | 104528 | 121869 | 139173 | 156434 | 60 |
| 1 | 000291 | 017743 | 035190 | 052626 | 070047 | 087446 | 104818 | 122158 | 139461 | 156722 | 59 |
| 2 | 000582 | 018034 | 035481 | 052917 | 070337 | 087735 | 105107 | 122447 | 139749 | 157009 | 58 |
| 3 | 000873 | 018325 | 035772 | 053207 | 070627 | 088025 | 105396 | 122735 | 140037 | 157296 | 57 |
| 4 | 001164 | 018616 | 036062 | 053498 | 070917 | 088315 | 105686 | 123024 | 140325 | 157584 | 56 |
| 5 | 001454 | 018907 | 036353 | 053788 | 071207 | 088605 | 105975 | 123313 | 140613 | 157871 | 55 |
| 6 | 001745 | 019197 | 036644 | 054079 | 071497 | 088894 | 106264 | 123601 | 140901 | 158158 | 54 |
| 7 | 002036 | 019488 | 036934 | 054369 | 071788 | 089184 | 106553 | 123890 | 141189 | 158445 | 53 |
| 8 | 002327 | 019779 | 037225 | 054660 | 072078 | 089474 | 106843 | 124179 | 141477 | 158732 | 52 |
| 9 | 002618 | 020070 | 037516 | 054950 | 072368 | 089763 | 107132 | 124467 | 141765 | 159020 | 51 |
| 10 | 002909 | 020361 | 037806 | 055241 | 072658 | 090053 | 107421 | 124756 | 142053 | 159307 | 50 |
| 11 | 003200 | 020652 | 038097 | 055531 | 072948 | 090343 | 107710 | 125045 | 142341 | 159594 | 49 |
| 12 | 003491 | 020942 | 038388 | 055822 | 073238 | 090633 | 107999 | 125333 | 142629 | 159881 | 48 |
| 13 | 003782 | 021233 | 038678 | 056112 | 073528 | 090922 | 108289 | 125622 | 142917 | 160168 | 47 |
| 14 | 004072 | 021524 | 038969 | 056402 | 073818 | 091212 | 108578 | 125910 | 143205 | 160455 | 46 |
| 15 | 004363 | 021815 | 039260 | 056693 | 074108 | 091502 | 108867 | 126199 | 143493 | 160743 | 45 |
| 16 | 004654 | 022106 | 039550 | 056983 | 074399 | 091791 | 109156 | 126488 | 143780 | 161030 | 44 |
| 17 | 004945 | 022397 | 039841 | 057274 | 074689 | 092081 | 109445 | 126776 | 144068 | 161317 | 43 |
| 18 | 005236 | 022687 | 040132 | 057564 | 074979 | 092371 | 109734 | 127065 | 144356 | 161604 | 42 |
| 19 | 005527 | 022978 | 040422 | 057854 | 075269 | 092660 | 110023 | 127353 | 144644 | 161891 | 41 |
| 20 | 005818 | 023269 | 040713 | 058145 | 075559 | 092950 | 110313 | 127642 | 144932 | 162178 | 40 |
| 21 | 006109 | 023560 | 041004 | 058435 | 075849 | 093239 | 110602 | 127930 | 145220 | 162465 | 39 |
| 22 | 006399 | 023851 | 041294 | 058726 | 076139 | 093529 | 110891 | 128219 | 145507 | 162752 | 38 |
| 23 | 006690 | 024141 | 041585 | 059016 | 076429 | 093819 | 111180 | 128507 | 145795 | 163039 | 37 |
| 24 | 006981 | 024432 | 041876 | 059306 | 076719 | 094108 | 111469 | 128796 | 146083 | 163326 | 36 |
| 25 | 007272 | 024723 | 042166 | 059597 | 077009 | 094398 | 111758 | 129084 | 146371 | 163613 | 35 |
| 26 | 007563 | 025014 | 042457 | 059887 | 077299 | 094687 | 112047 | 129373 | 146659 | 163900 | 34 |
| 27 | 007854 | 025305 | 042748 | 060177 | 077589 | 094977 | 112336 | 129661 | 146946 | 164187 | 33 |
| 28 | 008145 | 025595 | 043038 | 060468 | 077879 | 095267 | 112625 | 129949 | 147234 | 164474 | 32 |
| 29 | 008436 | 025886 | 043329 | 060758 | 078169 | 095556 | 112914 | 130238 | 147522 | 164761 | 31 |
| 30 | 008727 | 026177 | 043619 | 061049 | 078459 | 095846 | 113203 | 130526 | 147809 | 165048 | 30 |
| 31 | 009017 | 026468 | 043910 | 061339 | 078749 | 096135 | 113492 | 130815 | 148097 | 165334 | 29 |
| 32 | 009308 | 026759 | 044201 | 061629 | 079039 | 096425 | 113781 | 131103 | 148385 | 165621 | 28 |
| 33 | 009599 | 027049 | 044491 | 061920 | 079329 | 096714 | 114070 | 131391 | 148672 | 165908 | 27 |
| 34 | 009890 | 027340 | 044782 | 062210 | 079619 | 097004 | 114359 | 131680 | 148960 | 166195 | 26 |
| 35 | 010181 | 027631 | 045072 | 062500 | 079909 | 097293 | 114648 | 131968 | 149248 | 166482 | 25 |
| 36 | 010472 | 027922 | 045363 | 062791 | 080199 | 097583 | 114937 | 132256 | 149535 | 166769 | 24 |
| 37 | 010763 | 028212 | 045654 | 063081 | 080489 | 097872 | 115226 | 132545 | 149823 | 167056 | 23 |
| 38 | 011054 | 028503 | 045944 | 063371 | 080779 | 098162 | 115515 | 132833 | 150111 | 167342 | 22 |
| 39 | 011344 | 028794 | 046235 | 063661 | 081069 | 098451 | 115804 | 133121 | 150398 | 167629 | 21 |
| 40 | 011635 | 029085 | 046525 | 063952 | 081359 | 098741 | 116093 | 133410 | 150686 | 167916 | 20 |
| 41 | 011926 | 029375 | 046816 | 064242 | 081649 | 099030 | 116382 | 133698 | 150973 | 168203 | 19 |
| 42 | 012217 | 029666 | 047106 | 064532 | 081939 | 099320 | 116671 | 133986 | 151261 | 168489 | 18 |
| 43 | 012508 | 029957 | 047397 | 064823 | 082228 | 099609 | 116960 | 134274 | 151548 | 168776 | 17 |
| 44 | 012799 | 030248 | 047688 | 065113 | 082518 | 099899 | 117249 | 134563 | 151836 | 169063 | 16 |
| 45 | 013090 | 030539 | 047978 | 065403 | 082808 | 100188 | 117537 | 134851 | 152123 | 169350 | 15 |
| 46 | 013380 | 030829 | 048269 | 065693 | 083098 | 100477 | 117826 | 135139 | 152411 | 169636 | 14 |
| 47 | 013671 | 031120 | 048559 | 065984 | 083388 | 100767 | 118115 | 135427 | 152698 | 169923 | 13 |
| 48 | 013962 | 031411 | 048850 | 066274 | 083678 | 101056 | 118404 | 135716 | 152986 | 170209 | 12 |
| 49 | 014253 | 031702 | 049140 | 066564 | 083968 | 101346 | 118693 | 136004 | 153273 | 170496 | 11 |
| 50 | 014544 | 031992 | 049431 | 066854 | 084258 | 101635 | 118982 | 136292 | 153561 | 170783 | 10 |
| 51 | 014835 | 032283 | 049721 | 067145 | 084547 | 101924 | 119270 | 136580 | 153848 | 171069 | 9 |
| 52 | 015126 | 032574 | 050012 | 067435 | 084837 | 102214 | 119559 | 136868 | 154136 | 171356 | 8 |
| 53 | 015416 | 032864 | 050302 | 067725 | 085127 | 102503 | 119848 | 137156 | 154423 | 171643 | 7 |
| 54 | 015707 | 033155 | 050593 | 068015 | 085417 | 102793 | 120137 | 137445 | 154710 | 171929 | 6 |
| 55 | 015998 | 033446 | 050883 | 068306 | 085707 | 103082 | 120426 | 137733 | 154998 | 172216 | 5 |
| 56 | 016289 | 033737 | 051174 | 068596 | 085997 | 103371 | 120714 | 138021 | 155285 | 172502 | 4 |
| 57 | 016580 | 034027 | 051464 | 068886 | 086286 | 103661 | 121003 | 138309 | 155572 | 172789 | 3 |
| 58 | 016871 | 034318 | 051755 | 069176 | 086576 | 103950 | 121292 | 138597 | 155860 | 173075 | 2 |
| 59 | 017162 | 034609 | 052045 | 069466 | 086866 | 104239 | 121581 | 138885 | 156147 | 173362 | 1 |
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| M | 89° | 88° | 87° | 86° | 85° | 84° | 83° | 82° | 81° | 80° | M |

Natural Co-sines.

| Diff. to 100″ | 485 | 485 | 484 | 484 | 483 | 483 | 482 | 481 | 480 | 478 | |
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Digitized by Google

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| 2 | 174221 | 191380 | 208481 | 225518 | 242486 | 259381 | 276197 | 292928 | 309570 | 326118 | 58 |
| 3 | 174508 | 191666 | 208765 | 225801 | 242769 | 259662 | 276476 | 293206 | 309847 | 326393 | 57 |
| 4 | 174794 | 191951 | 209050 | 226085 | 243051 | 259943 | 276756 | 293484 | 310123 | 326668 | 56 |
| 5 | 175080 | 192237 | 209334 | 226368 | 243333 | 260224 | 277035 | 293762 | 310400 | 326943 | 55 |
| 6 | 175367 | 192522 | 209619 | 226651 | 243615 | 260505 | 277315 | 294040 | 310676 | 327218 | 54 |
| 7 | 175653 | 192807 | 209903 | 226935 | 243897 | 260785 | 277594 | 294318 | 310953 | 327493 | 53 |
| 8 | 175939 | 193093 | 210187 | 227218 | 244179 | 261066 | 277874 | 294596 | 311229 | 327768 | 52 |
| 9 | 176226 | 193378 | 210472 | 227501 | 244461 | 261347 | 278153 | 294874 | 311506 | 328042 | 51 |
| 10 | 176512 | 193664 | 210756 | 227784 | 244743 | 261628 | 278432 | 295152 | 311782 | 328317 | 50 |
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| 12 | 177085 | 194234 | 211325 | 228351 | 245307 | 262189 | 278991 | 295708 | 312335 | 328867 | 48 |
| 13 | 177371 | 194520 | 211609 | 228634 | 245589 | 262470 | 279270 | 295986 | 312611 | 329141 | 47 |
| 14 | 177657 | 194805 | 211893 | 228917 | 245871 | 262751 | 279550 | 296264 | 312888 | 329416 | 46 |
| 15 | 177944 | 195090 | 212178 | 229200 | 246153 | 263031 | 279829 | 296542 | 313164 | 329691 | 45 |
| 16 | 178230 | 195376 | 212462 | 229484 | 246435 | 263312 | 280108 | 296819 | 313440 | 329965 | 44 |
| 17 | 178516 | 195661 | 212746 | 229767 | 246717 | 263592 | 280388 | 297097 | 313716 | 330240 | 43 |
| 18 | 178802 | 195946 | 213030 | 230050 | 246999 | 263873 | 280667 | 297375 | 313992 | 330514 | 42 |
| 19 | 179088 | 196231 | 213315 | 230333 | 247281 | 264154 | 280946 | 297653 | 314269 | 330789 | 41 |
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| 22 | 179947 | 197087 | 214167 | 231182 | 248126 | 264995 | 281783 | 298486 | 315097 | 331612 | 38 |
| 23 | 180233 | 197372 | 214451 | 231465 | 248408 | 265276 | 282062 | 298763 | 315373 | 331887 | 37 |
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| 33 | 183094 | 200223 | 217292 | 234294 | 251225 | 268079 | 284852 | 301538 | 318132 | 334629 | 27 |
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| 42 | 185667 | 202787 | 219846 | 236838 | 253758 | 270600 | 287361 | 304033 | 320613 | 337095 | 18 |
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| 50 | 187953 | 205065 | 222116 | 239098 | 256008 | 272840 | 289589 | 306249 | 322816 | 339285 | 10 |
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| 52 | 188524 | 205635 | 222683 | 239663 | 256571 | 273400 | 290145 | 306803 | 323367 | 339832 | 8 |
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| 55 | 189381 | 206489 | 223534 | 240510 | 257414 | 274239 | 290981 | 307633 | 324193 | 340653 | 5 |
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| 58 | 190238 | 207343 | 224384 | 241357 | 258257 | 275078 | 291815 | 308464 | 325018 | 341473 | 2 |
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| M | 79° | 78° | 77° | 76° | 75° | 74° | 73° | 72° | 71° | 70° | M |

Natural Co-sines.

| Diff. to 100″ | 477 | 475 | 473 | 471 | 469 | 467 | 465 | 462 | 460 | 457 | |
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| 3 | 342840 | 359183 | 375416 | 391534 | 407534 | 423409 | 439155 | 454768 | 470242 | 485573 | 57 |
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| 5 | 343387 | 359725 | 375955 | 392070 | 408065 | 423936 | 439678 | 455286 | 470755 | 486081 | 55 |
| 6 | 343660 | 359997 | 376224 | 392337 | 408330 | 424199 | 439939 | 455545 | 471012 | 486335 | 54 |
| 7 | 343933 | 360268 | 376494 | 392605 | 408596 | 424463 | 440200 | 455804 | 471268 | 486590 | 53 |
| 8 | 344206 | 360540 | 376763 | 392872 | 408861 | 424726 | 440462 | 456063 | 471525 | 486844 | 52 |
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| 13 | 345571 | 361896 | 378110 | 394209 | 410188 | 426042 | 441767 | 457357 | 472807 | 488114 | 47 |
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| 15 | 346117 | 362438 | 378649 | 394744 | 410719 | 426569 | 442289 | 457874 | 473320 | 488621 | 45 |
| 16 | 346390 | 362709 | 378918 | 395011 | 410984 | 426832 | 442550 | 458133 | 473576 | 488875 | 44 |
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| 23 | 348299 | 364606 | 380801 | 396881 | 412840 | 428672 | 444375 | 459942 | 475368 | 490650 | 37 |
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| 40 | 352931 | 369206 | 385369 | 401415 | 417338 | 433135 | 448799 | 464327 | 479713 | 494953 | 20 |
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| 42 | 353475 | 369747 | 385906 | 401948 | 417867 | 433659 | 449319 | 464842 | 480223 | 495459 | 18 |
| 43 | 353747 | 370017 | 386174 | 402214 | 418131 | 433921 | 449579 | 465100 | 480479 | 495711 | 17 |
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| 46 | 354563 | 370828 | 386979 | 403013 | 418924 | 434707 | 450358 | 465872 | 481244 | 496469 | 14 |
| 47 | 354835 | 371098 | 387247 | 403279 | 419188 | 434969 | 450618 | 466129 | 481499 | 496722 | 13 |
| 48 | 355107 | 371368 | 387516 | 403545 | 419452 | 435231 | 450878 | 466387 | 481754 | 496974 | 12 |
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| 50 | 355651 | 371908 | 388052 | 404078 | 419980 | 435755 | 451397 | 466901 | 482263 | 497479 | 10 |
| 51 | 355923 | 372178 | 388320 | 404344 | 420244 | 436017 | 451656 | 467158 | 482518 | 497731 | 9 |
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| 54 | 356738 | 372988 | 389124 | 405142 | 421036 | 436802 | 452435 | 467930 | 483282 | 498488 | 6 |
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| 57 | 357553 | 373797 | 389928 | 405939 | 421827 | 437587 | 453213 | 468701 | 484046 | 499244 | 3 |
| 58 | 357825 | 374067 | 390196 | 406205 | 422091 | 437848 | 453472 | 468958 | 484301 | 499496 | 2 |
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| 60 | 358368 | 374607 | 390731 | 406737 | 422618 | 438371 | 453990 | 469472 | 484810 | 500000 | 0 |
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Natural Co-sines.

| Diff. to 100″ | 454 | 451 | 448 | 445 | 441 | 438 | 434 | 430 | 426 | 422 | |
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| 31 | 507789 | 522747 | 537545 | 552180 | 566646 | 580940 | 595057 | 608992 | 622742 | 636303 | 29 |
| 32 | 508040 | 522995 | 537790 | 552422 | 566886 | 581176 | 595290 | 609223 | 622970 | 636527 | 28 |
| 33 | 508290 | 523242 | 538035 | 552664 | 567125 | 581413 | 595524 | 609454 | 623197 | 636751 | 27 |
| 34 | 508541 | 523490 | 538281 | 552907 | 567365 | 581650 | 595758 | 609684 | 623425 | 636976 | 26 |
| 35 | 508791 | 523738 | 538526 | 553149 | 567604 | 581886 | 595991 | 609915 | 623652 | 637200 | 25 |
| 36 | 509041 | 523986 | 538771 | 553392 | 567844 | 582123 | 596225 | 610145 | 623880 | 637424 | 24 |
| 37 | 509292 | 524234 | 539016 | 553634 | 568083 | 582359 | 596458 | 610376 | 624107 | 637648 | 23 |
| 38 | 509542 | 524481 | 539261 | 553876 | 568323 | 582596 | 596692 | 610606 | 624334 | 637872 | 22 |
| 39 | 509792 | 524729 | 539506 | 554118 | 568562 | 582832 | 596925 | 610836 | 624561 | 638096 | 21 |
| 40 | 510043 | 524977 | 539751 | 554360 | 568801 | 583069 | 597159 | 611067 | 624789 | 638320 | 20 |
| 41 | 510293 | 525224 | 539996 | 554602 | 569040 | 583305 | 597392 | 611297 | 625016 | 638544 | 19 |
| 42 | 510543 | 525472 | 540240 | 554844 | 569280 | 583541 | 597625 | 611527 | 625243 | 638768 | 18 |
| 43 | 510793 | 525719 | 540485 | 555086 | 569519 | 583777 | 597858 | 611757 | 625470 | 638992 | 17 |
| 44 | 511043 | 525967 | 540730 | 555328 | 569758 | 584014 | 598092 | 611987 | 625697 | 639215 | 16 |
| 45 | 511293 | 526214 | 540974 | 555570 | 569997 | 584250 | 598325 | 612217 | 625923 | 639439 | 15 |
| 46 | 511543 | 526461 | 541219 | 555812 | 570236 | 584486 | 598558 | 612447 | 626150 | 639663 | 14 |
| 47 | 511793 | 526709 | 541464 | 556054 | 570475 | 584722 | 598791 | 612677 | 626377 | 639886 | 13 |
| 48 | 512043 | 526956 | 541708 | 556296 | 570714 | 584958 | 599024 | 612907 | 626604 | 640110 | 12 |
| 49 | 512293 | 527203 | 541953 | 556537 | 570952 | 585194 | 599256 | 613137 | 626830 | 640333 | 11 |
| 50 | 512543 | 527450 | 542197 | 556779 | 571191 | 585429 | 599489 | 613367 | 627057 | 640557 | 10 |
| 51 | 512792 | 527697 | 542442 | 557021 | 571430 | 585665 | 599722 | 613596 | 627284 | 640780 | 9 |
| 52 | 513042 | 527944 | 542686 | 557262 | 571669 | 585901 | 599955 | 613826 | 627510 | 641003 | 8 |
| 53 | 513292 | 528191 | 542930 | 557504 | 571907 | 586137 | 600188 | 614056 | 627737 | 641226 | 7 |
| 54 | 513541 | 528438 | 543174 | 557745 | 572146 | 586372 | 600420 | 614285 | 627963 | 641450 | 6 |
| 55 | 513791 | 528685 | 543419 | 557987 | 572384 | 586608 | 600653 | 614515 | 628189 | 641673 | 5 |
| 56 | 514040 | 528932 | 543663 | 558228 | 572623 | 586844 | 600885 | 614744 | 628416 | 641896 | 4 |
| 57 | 514290 | 529179 | 543907 | 558469 | 572861 | 587079 | 601118 | 614974 | 628642 | 642119 | 3 |
| 58 | 514539 | 529426 | 544151 | 558710 | 573100 | 587314 | 601350 | 615203 | 628868 | 642342 | 2 |
| 59 | 514789 | 529673 | 544395 | 558952 | 573338 | 587550 | 601583 | 615432 | 629094 | 642565 | 1 |
| 60 | 515038 | 529919 | 544639 | 559193 | 573576 | 587785 | 601815 | 615661 | 629320 | 642788 | 0 |
| M | 59° | 58° | 57° | 56° | 55° | 54° | 53° | 52° | 51° | 50° | M |

Natural Co-sines.

| Diff. to 100″ | 418 | 413 | 409 | 404 | 399 | 394 | 390 | 385 | 380 | 374 | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| M | 40° | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 642788 | 656059 | 669131 | 681998 | 694658 | 707107 | 719340 | 731354 | 743145 | 754710 | 60 |
| 1 | 643010 | 656279 | 669347 | 682211 | 694868 | 707312 | 719542 | 731552 | 743339 | 754900 | 59 |
| 2 | 643233 | 656498 | 669563 | 682424 | 695077 | 707518 | 719744 | 731750 | 743534 | 755091 | 58 |
| 3 | 643456 | 656717 | 669779 | 682636 | 695286 | 707723 | 719946 | 731949 | 743728 | 755282 | 57 |
| 4 | 643679 | 656937 | 669995 | 682849 | 695495 | 707929 | 720148 | 732147 | 743923 | 755472 | 56 |
| 5 | 643901 | 657156 | 670211 | 683061 | 695704 | 708134 | 720349 | 732345 | 744117 | 755663 | 55 |
| 6 | 644124 | 657375 | 670427 | 683274 | 695913 | 708340 | 720551 | 732543 | 744312 | 755853 | 54 |
| 7 | 644346 | 657594 | 670642 | 683486 | 696122 | 708545 | 720753 | 732741 | 744506 | 756044 | 53 |
| 8 | 644569 | 657814 | 670858 | 683698 | 696330 | 708750 | 720954 | 732939 | 744700 | 756234 | 52 |
| 9 | 644791 | 658033 | 671074 | 683911 | 696539 | 708956 | 721156 | 733137 | 744894 | 756425 | 51 |
| 10 | 645013 | 658252 | 671289 | 684123 | 696748 | 709161 | 721357 | 733334 | 745088 | 756615 | 50 |
| 11 | 645236 | 658471 | 671505 | 684335 | 696957 | 709366 | 721559 | 733532 | 745282 | 756805 | 49 |
| 12 | 645458 | 658689 | 671721 | 684547 | 697165 | 709571 | 721760 | 733730 | 745476 | 756995 | 48 |
| 13 | 645680 | 658908 | 671936 | 684759 | 697374 | 709776 | 721962 | 733927 | 745670 | 757185 | 47 |
| 14 | 645902 | 659127 | 672151 | 684971 | 697582 | 709981 | 722163 | 734125 | 745864 | 757375 | 46 |
| 15 | 646124 | 659346 | 672367 | 685183 | 697790 | 710185 | 722364 | 734323 | 746057 | 757565 | 45 |
| 16 | 646346 | 659565 | 672582 | 685395 | 697999 | 710390 | 722565 | 734520 | 746251 | 757755 | 44 |
| 17 | 646568 | 659783 | 672797 | 685607 | 698207 | 710595 | 722766 | 734717 | 746445 | 757945 | 43 |
| 18 | 646790 | 660002 | 673013 | 685818 | 698415 | 710799 | 722967 | 734915 | 746638 | 758134 | 42 |
| 19 | 647012 | 660220 | 673228 | 686030 | 698623 | 711004 | 723168 | 735112 | 746832 | 758324 | 41 |
| 20 | 647233 | 660439 | 673443 | 686242 | 698832 | 711209 | 723369 | 735309 | 747025 | 758514 | 40 |
| 21 | 647455 | 660657 | 673658 | 686453 | 699040 | 711413 | 723570 | 735506 | 747218 | 758703 | 39 |
| 22 | 647677 | 660875 | 673873 | 686665 | 699248 | 711617 | 723771 | 735703 | 747412 | 758893 | 38 |
| 23 | 647898 | 661094 | 674088 | 686876 | 699455 | 711822 | 723971 | 735900 | 747605 | 759082 | 37 |
| 24 | 648120 | 661312 | 674302 | 687088 | 699663 | 712026 | 724172 | 736097 | 747798 | 759271 | 36 |
| 25 | 648341 | 661530 | 674517 | 687299 | 699871 | 712230 | 724372 | 736294 | 747991 | 759461 | 35 |
| 26 | 648563 | 661748 | 674732 | 687510 | 700079 | 712434 | 724573 | 736491 | 748184 | 759650 | 34 |
| 27 | 648784 | 661966 | 674947 | 687721 | 700287 | 712639 | 724773 | 736687 | 748377 | 759839 | 33 |
| 28 | 649006 | 662184 | 675161 | 687932 | 700494 | 712843 | 724974 | 736884 | 748570 | 760028 | 32 |
| 29 | 649227 | 662402 | 675376 | 688144 | 700702 | 713047 | 725174 | 737081 | 748763 | 760217 | 31 |
| 30 | 649448 | 662620 | 675590 | 688355 | 700909 | 713250 | 725374 | 737277 | 748956 | 760406 | 30 |
| 31 | 649669 | 662838 | 675805 | 688566 | 701117 | 713454 | 725575 | 737474 | 749148 | 760595 | 29 |
| 32 | 649890 | 663056 | 676019 | 688776 | 701324 | 713658 | 725775 | 737670 | 749341 | 760784 | 28 |
| 33 | 650111 | 663273 | 676233 | 688987 | 701531 | 713862 | 725975 | 737867 | 749534 | 760972 | 27 |
| 34 | 650332 | 663491 | 676448 | 689198 | 701739 | 714066 | 726175 | 738063 | 749726 | 761161 | 26 |
| 35 | 650553 | 663709 | 676662 | 689409 | 701946 | 714269 | 726375 | 738259 | 749919 | 761350 | 25 |
| 36 | 650774 | 663926 | 676876 | 689620 | 702153 | 714473 | 726575 | 738455 | 750111 | 761538 | 24 |
| 37 | 650995 | 664144 | 677090 | 689830 | 702360 | 714676 | 726775 | 738651 | 750303 | 761727 | 23 |
| 38 | 651216 | 664361 | 677304 | 690041 | 702567 | 714880 | 726974 | 738848 | 750496 | 761915 | 22 |
| 39 | 651437 | 664579 | 677518 | 690251 | 702774 | 715083 | 727174 | 739043 | 750688 | 762104 | 21 |
| 40 | 651657 | 664796 | 677732 | 690462 | 702981 | 715286 | 727374 | 739239 | 750880 | 762292 | 20 |
| 41 | 651878 | 665013 | 677946 | 690672 | 703188 | 715490 | 727573 | 739435 | 751072 | 762480 | 19 |
| 42 | 652098 | 665230 | 678160 | 690882 | 703395 | 715693 | 727773 | 739631 | 751264 | 762668 | 18 |
| 43 | 652319 | 665448 | 678373 | 691093 | 703601 | 715896 | 727972 | 739827 | 751456 | 762856 | 17 |
| 44 | 652539 | 665665 | 678587 | 691303 | 703808 | 716099 | 728172 | 740023 | 751648 | 763044 | 16 |
| 45 | 652760 | 665882 | 678801 | 691513 | 704015 | 716302 | 728371 | 740218 | 751840 | 763232 | 15 |
| 46 | 652980 | 666099 | 679014 | 691723 | 704221 | 716505 | 728570 | 740414 | 752032 | 763420 | 14 |
| 47 | 653200 | 666316 | 679228 | 691933 | 704428 | 716708 | 728769 | 740609 | 752223 | 763608 | 13 |
| 48 | 653421 | 666532 | 679441 | 692143 | 704634 | 716911 | 728969 | 740805 | 752415 | 763796 | 12 |
| 49 | 653641 | 666749 | 679655 | 692353 | 704841 | 717113 | 729168 | 741000 | 752606 | 763984 | 11 |
| 50 | 653861 | 666966 | 679868 | 692563 | 705047 | 717316 | 729367 | 741195 | 752798 | 764171 | 10 |
| 51 | 654081 | 667183 | 680081 | 692773 | 705253 | 717519 | 729566 | 741391 | 752989 | 764359 | 9 |
| 52 | 654301 | 667399 | 680295 | 692983 | 705459 | 717721 | 729765 | 741586 | 753181 | 764547 | 8 |
| 53 | 654521 | 667616 | 680508 | 693192 | 705665 | 717924 | 729963 | 741781 | 753372 | 764734 | 7 |
| 54 | 654741 | 667833 | 680721 | 693402 | 705872 | 718126 | 730162 | 741976 | 753563 | 764921 | 6 |
| 55 | 654961 | 668049 | 680934 | 693611 | 706078 | 718329 | 730361 | 742171 | 753755 | 765109 | 5 |
| 56 | 655180 | 668265 | 681147 | 693821 | 706284 | 718531 | 730560 | 742366 | 753946 | 765296 | 4 |
| 57 | 655400 | 668482 | 681360 | 694030 | 706489 | 718733 | 730758 | 742561 | 754137 | 765483 | 3 |
| 58 | 655620 | 668698 | 681573 | 694240 | 706695 | 718936 | 730957 | 742755 | 754328 | 765670 | 2 |
| 59 | 655839 | 668914 | 681786 | 694449 | 706901 | 719138 | 731155 | 742950 | 754519 | 765857 | 1 |
| 60 | 656059 | 669131 | 681998 | 694658 | 707107 | 719340 | 731354 | 743145 | 754710 | 766044 | 0 |
| M | 49° | 48° | 47° | 46° | 45° | 44° | 43° | 42° | 41° | 40° | M |

Natural Co-sines.

| Diff. to 100″ | 369 | 363 | 357 | 352 | 346 | 340 | 334 | 327 | 321 | 315 | |
|---|---|---|---|---|---|---|---|---|---|---|---|

Digitized by Google

| M | 50° | 51° | 52° | 53° | 54° | 55° | 56° | 57° | 58° | 59° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 766044 | 777146 | 788011 | 798636 | 809017 | 819152 | 829038 | 838671 | 848048 | 857167 | 60 |
| 1 | 766231 | 777329 | 788190 | 798811 | 809188 | 819319 | 829200 | 838829 | 848202 | 857317 | 59 |
| 2 | 766418 | 777512 | 788369 | 798985 | 809359 | 819486 | 829363 | 838987 | 848356 | 857467 | 58 |
| 3 | 766605 | 777695 | 788548 | 799160 | 809530 | 819652 | 829525 | 839146 | 848510 | 857616 | 57 |
| 4 | 766792 | 777878 | 788727 | 799335 | 809700 | 819819 | 829688 | 839304 | 848664 | 857766 | 56 |
| 5 | 766979 | 778060 | 788905 | 799510 | 809871 | 819985 | 829850 | 839462 | 848818 | 857915 | 55 |
| 6 | 767165 | 778243 | 789084 | 799685 | 810042 | 820152 | 830012 | 839620 | 848972 | 858065 | 54 |
| 7 | 767352 | 778426 | 789263 | 799859 | 810212 | 820318 | 830174 | 839778 | 849125 | 858214 | 53 |
| 8 | 767538 | 778608 | 789441 | 800034 | 810383 | 820485 | 830337 | 839936 | 849279 | 858364 | 52 |
| 9 | 767725 | 778791 | 789620 | 800208 | 810553 | 820651 | 830499 | 840094 | 849433 | 858513 | 51 |
| 10 | 767911 | 778973 | 789798 | 800383 | 810723 | 820817 | 830661 | 840251 | 849586 | 858662 | 50 |
| 11 | 768097 | 779156 | 789977 | 800557 | 810894 | 820983 | 830823 | 840409 | 849739 | 858811 | 49 |
| 12 | 768284 | 779338 | 790155 | 800731 | 811064 | 821149 | 830984 | 840567 | 849893 | 858960 | 48 |
| 13 | 768470 | 779520 | 790333 | 800906 | 811234 | 821315 | 831146 | 840724 | 850046 | 859109 | 47 |
| 14 | 768656 | 779702 | 790511 | 801080 | 811404 | 821481 | 831308 | 840882 | 850199 | 859258 | 46 |
| 15 | 768842 | 779884 | 790690 | 801254 | 811574 | 821647 | 831470 | 841039 | 850352 | 859406 | 45 |
| 16 | 769028 | 780067 | 790868 | 801428 | 811744 | 821813 | 831631 | 841196 | 850505 | 859555 | 44 |
| 17 | 769214 | 780249 | 791046 | 801602 | 811914 | 821978 | 831793 | 841354 | 850658 | 859704 | 43 |
| 18 | 769400 | 780430 | 791224 | 801776 | 812084 | 822144 | 831954 | 841511 | 850811 | 859852 | 42 |
| 19 | 769585 | 780612 | 791401 | 801949 | 812253 | 822310 | 832115 | 841668 | 850964 | 860001 | 41 |
| 20 | 769771 | 780794 | 791579 | 802123 | 812423 | 822475 | 832277 | 841825 | 851117 | 860149 | 40 |
| 21 | 769957 | 780976 | 791757 | 802297 | 812592 | 822641 | 832438 | 841982 | 851269 | 860297 | 39 |
| 22 | 770142 | 781157 | 791935 | 802470 | 812762 | 822806 | 832599 | 842139 | 851422 | 860446 | 38 |
| 23 | 770328 | 781339 | 792112 | 802644 | 812931 | 822971 | 832760 | 842296 | 851575 | 860594 | 37 |
| 24 | 770513 | 781520 | 792290 | 802817 | 813101 | 823136 | 832921 | 842452 | 851727 | 860742 | 36 |
| 25 | 770699 | 781702 | 792467 | 802991 | 813270 | 823302 | 833082 | 842609 | 851879 | 860890 | 35 |
| 26 | 770884 | 781883 | 792644 | 803164 | 813439 | 823467 | 833243 | 842766 | 852032 | 861038 | 34 |
| 27 | 771069 | 782065 | 792822 | 803337 | 813608 | 823632 | 833404 | 842922 | 852184 | 861186 | 33 |
| 28 | 771254 | 782246 | 792999 | 803511 | 813778 | 823797 | 833565 | 843079 | 852336 | 861334 | 32 |
| 29 | 771440 | 782427 | 793176 | 803684 | 813947 | 823961 | 833725 | 843235 | 852488 | 861481 | 31 |
| 30 | 771625 | 782608 | 793353 | 803857 | 814116 | 824126 | 833886 | 843391 | 852640 | 861629 | 30 |
| 31 | 771810 | 782789 | 793530 | 804030 | 814284 | 824291 | 834046 | 843548 | 852792 | 861777 | 29 |
| 32 | 771995 | 782970 | 793707 | 804203 | 814453 | 824456 | 834207 | 843704 | 852944 | 861924 | 28 |
| 33 | 772179 | 783151 | 793884 | 804376 | 814622 | 824620 | 834367 | 843860 | 853096 | 862072 | 27 |
| 34 | 772364 | 783332 | 794061 | 804548 | 814791 | 824785 | 834527 | 844016 | 853248 | 862219 | 26 |
| 35 | 772549 | 783513 | 794238 | 804721 | 814959 | 824949 | 834688 | 844172 | 853399 | 862366 | 25 |
| 36 | 772734 | 783693 | 794415 | 804894 | 815128 | 825113 | 834848 | 844328 | 853551 | 862514 | 24 |
| 37 | 772918 | 783874 | 794591 | 805066 | 815296 | 825278 | 835008 | 844484 | 853702 | 862661 | 23 |
| 38 | 773103 | 784055 | 794768 | 805239 | 815465 | 825442 | 835168 | 844640 | 853854 | 862808 | 22 |
| 39 | 773287 | 784235 | 794944 | 805411 | 815633 | 825606 | 835328 | 844795 | 854005 | 862955 | 21 |
| 40 | 773472 | 784416 | 795121 | 805584 | 815801 | 825770 | 835488 | 844951 | 854156 | 863102 | 20 |
| 41 | 773656 | 784596 | 795297 | 805756 | 815969 | 825934 | 835648 | 845106 | 854308 | 863249 | 19 |
| 42 | 773840 | 784776 | 795473 | 805928 | 816138 | 826098 | 835807 | 845262 | 854459 | 863396 | 18 |
| 43 | 774024 | 784957 | 795650 | 806100 | 816306 | 826262 | 835967 | 845417 | 854610 | 863542 | 17 |
| 44 | 774209 | 785137 | 795826 | 806273 | 816474 | 826426 | 836127 | 845573 | 854761 | 863689 | 16 |
| 45 | 774393 | 785317 | 796002 | 806445 | 816642 | 826590 | 836286 | 845728 | 854912 | 863836 | 15 |
| 46 | 774577 | 785497 | 796178 | 806617 | 816809 | 826753 | 836446 | 845883 | 855063 | 863982 | 14 |
| 47 | 774761 | 785677 | 796354 | 806788 | 816977 | 826917 | 836605 | 846038 | 855214 | 864128 | 13 |
| 48 | 774944 | 785857 | 796530 | 806960 | 817145 | 827081 | 836764 | 846193 | 855364 | 864275 | 12 |
| 49 | 775128 | 786037 | 796706 | 807132 | 817313 | 827244 | 836924 | 846348 | 855515 | 864421 | 11 |
| 50 | 775312 | 786217 | 796882 | 807304 | 817480 | 827407 | 837083 | 846503 | 855665 | 864567 | 10 |
| 51 | 775496 | 786396 | 797057 | 807475 | 817648 | 827571 | 837242 | 846658 | 855816 | 864713 | 9 |
| 52 | 775679 | 786576 | 797233 | 807647 | 817815 | 827734 | 837401 | 846813 | 855966 | 864860 | 8 |
| 53 | 775863 | 786756 | 797408 | 807818 | 817982 | 827897 | 837560 | 846967 | 856117 | 865006 | 7 |
| 54 | 776046 | 786935 | 797584 | 807990 | 818150 | 828060 | 837719 | 847122 | 856267 | 865151 | 6 |
| 55 | 776230 | 787114 | 797759 | 808161 | 818317 | 828223 | 837878 | 847277 | 856417 | 865297 | 5 |
| 56 | 776413 | 787294 | 797935 | 808333 | 818484 | 828386 | 838036 | 847431 | 856567 | 865443 | 4 |
| 57 | 776596 | 787473 | 798110 | 808504 | 818651 | 828549 | 838195 | 847585 | 856718 | 865589 | 3 |
| 58 | 776780 | 787652 | 798285 | 808675 | 818818 | 828712 | 838354 | 847740 | 856868 | 865734 | 2 |
| 59 | 776963 | 787832 | 798460 | 808846 | 818985 | 828875 | 838512 | 847894 | 857017 | 865880 | 1 |
| 60 | 777146 | 788011 | 798636 | 809017 | 819152 | 829038 | 838671 | 848048 | 857167 | 866025 | 0 |
| M | 39° | 38° | 37° | 36° | 35° | 34° | 33° | 32° | 31° | 30° | M |

Natural Co-sines.

| Diff. to 100″ | 309 | 302 | 295 | 288 | 282 | 275 | 268 | 260 | 253 | 246 | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| M | 60° | 61° | 62° | 63° | 64° | 65° | 66° | 67° | 68° | 69° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 866025 | 874620 | 882948 | 891007 | 898794 | 906308 | 913545 | 920505 | 927184 | 933580 | 60 |
| 1 | 866171 | 874761 | 883084 | 891139 | 898922 | 906431 | 913664 | 920618 | 927293 | 933685 | 59 |
| 2 | 866316 | 874902 | 883221 | 891270 | 899049 | 906554 | 913782 | 920732 | 927402 | 933789 | 58 |
| 3 | 866461 | 875042 | 883357 | 891402 | 899176 | 906676 | 913900 | 920846 | 927519 | 933893 | 57 |
| 4 | 866607 | 875183 | 883493 | 891534 | 899304 | 906799 | 914018 | 920959 | 927619 | 933997 | 56 |
| 5 | 866752 | 875324 | 883629 | 891666 | 899431 | 906922 | 914136 | 921072 | 927728 | 934101 | 55 |
| 6 | 866897 | 875465 | 883766 | 891798 | 899558 | 907044 | 914254 | 921185 | 927836 | 934204 | 54 |
| 7 | 867042 | 875605 | 883902 | 891929 | 899685 | 907166 | 914372 | 921299 | 927945 | 934308 | 53 |
| 8 | 867187 | 875746 | 884038 | 892061 | 899812 | 907289 | 914490 | 921412 | 928053 | 934412 | 52 |
| 9 | 867331 | 875886 | 884174 | 892192 | 899939 | 907411 | 914607 | 921525 | 928161 | 934515 | 51 |
| 10 | 867476 | 876026 | 884309 | 892323 | 900065 | 907533 | 914725 | 921638 | 928270 | 934619 | 50 |
| 11 | 867621 | 876167 | 884445 | 892455 | 900192 | 907655 | 914842 | 921750 | 928378 | 934722 | 49 |
| 12 | 867765 | 876307 | 884581 | 892586 | 900319 | 907777 | 914960 | 921863 | 928486 | 934826 | 48 |
| 13 | 867910 | 876447 | 884717 | 892717 | 900445 | 907899 | 915077 | 921976 | 928594 | 934929 | 47 |
| 14 | 868054 | 876587 | 884852 | 892848 | 900572 | 908021 | 915194 | 922088 | 928702 | 935032 | 46 |
| 15 | 868199 | 876727 | 884988 | 892979 | 900698 | 908143 | 915311 | 922201 | 928810 | 935135 | 45 |
| 16 | 868343 | 876867 | 885123 | 893110 | 900825 | 908265 | 915429 | 922313 | 928917 | 935238 | 44 |
| 17 | 868487 | 877006 | 885258 | 893241 | 900951 | 908387 | 915546 | 922426 | 929025 | 935341 | 43 |
| 18 | 868632 | 877146 | 885394 | 893371 | 901077 | 908508 | 915663 | 922538 | 929133 | 935444 | 42 |
| 19 | 868776 | 877286 | 885529 | 893502 | 901203 | 908630 | 915779 | 922650 | 929240 | 935547 | 41 |
| 20 | 868920 | 877425 | 885664 | 893633 | 901329 | 908751 | 915896 | 922762 | 929348 | 935650 | 40 |
| 21 | 869064 | 877565 | 885799 | 893763 | 901455 | 908872 | 916013 | 922874 | 929455 | 935752 | 39 |
| 22 | 869207 | 877704 | 885934 | 893894 | 901581 | 908994 | 916130 | 922986 | 929562 | 935855 | 38 |
| 23 | 869351 | 877844 | 886069 | 894024 | 901707 | 909115 | 916246 | 923098 | 929669 | 935957 | 37 |
| 24 | 869495 | 877982 | 886204 | 894154 | 901833 | 909236 | 916363 | 923210 | 929776 | 936060 | 36 |
| 25 | 869639 | 878122 | 886338 | 894284 | 901958 | 909357 | 916479 | 923322 | 929884 | 936162 | 35 |
| 26 | 869782 | 878261 | 886473 | 894415 | 902084 | 909478 | 916595 | 923434 | 929990 | 936264 | 34 |
| 27 | 869926 | 878400 | 886608 | 894545 | 902209 | 909599 | 916712 | 923545 | 930097 | 936366 | 33 |
| 28 | 870069 | 878539 | 886742 | 894675 | 902335 | 909720 | 916828 | 923657 | 930204 | 936468 | 32 |
| 29 | 870212 | 878678 | 886876 | 894805 | 902460 | 909841 | 916944 | 923768 | 930311 | 936570 | 31 |
| 30 | 870356 | 878817 | 887011 | 894934 | 902585 | 909961 | 917060 | 923880 | 930418 | 936672 | 30 |
| 31 | 870499 | 878956 | 887145 | 895064 | 902710 | 910082 | 917176 | 923991 | 930524 | 936774 | 29 |
| 32 | 870642 | 879095 | 887279 | 895194 | 902836 | 910202 | 917292 | 924102 | 930631 | 936876 | 28 |
| 33 | 870785 | 879233 | 887413 | 895323 | 902961 | 910323 | 917408 | 924213 | 930737 | 936977 | 27 |
| 34 | 870928 | 879372 | 887548 | 895453 | 903086 | 910443 | 917523 | 924324 | 930843 | 937079 | 26 |
| 35 | 871071 | 879510 | 887681 | 895582 | 903210 | 910563 | 917639 | 924435 | 930950 | 937181 | 25 |
| 36 | 871214 | 879649 | 887815 | 895712 | 903335 | 910684 | 917755 | 924546 | 931056 | 937282 | 24 |
| 37 | 871357 | 879787 | 887949 | 895841 | 903460 | 910804 | 917870 | 924657 | 931162 | 937383 | 23 |
| 38 | 871499 | 879925 | 888083 | 895970 | 903585 | 910924 | 917986 | 924768 | 931268 | 937485 | 22 |
| 39 | 871642 | 880063 | 888217 | 896099 | 903709 | 911044 | 918101 | 924878 | 931374 | 937586 | 21 |
| 40 | 871784 | 880201 | 888350 | 896229 | 903834 | 911164 | 918216 | 924989 | 931480 | 937687 | 20 |
| 41 | 871927 | 880339 | 888484 | 896358 | 903958 | 911284 | 918331 | 925099 | 931586 | 937788 | 19 |
| 42 | 872069 | 880477 | 888617 | 896486 | 904083 | 911403 | 918446 | 925210 | 931691 | 937889 | 18 |
| 43 | 872212 | 880615 | 888751 | 896615 | 904207 | 911523 | 918561 | 925320 | 931797 | 937990 | 17 |
| 44 | 872354 | 880753 | 888884 | 896744 | 904331 | 911643 | 918676 | 925430 | 931902 | 938091 | 16 |
| 45 | 872496 | 880891 | 889017 | 896873 | 904455 | 911762 | 918791 | 925541 | 932008 | 938191 | 15 |
| 46 | 872638 | 881028 | 889150 | 897001 | 904579 | 911881 | 918906 | 925651 | 932113 | 938292 | 14 |
| 47 | 872780 | 881166 | 889283 | 897130 | 904703 | 912001 | 919021 | 925761 | 932219 | 938393 | 13 |
| 48 | 872922 | 881303 | 889416 | 897258 | 904827 | 912120 | 919135 | 925871 | 932324 | 938493 | 12 |
| 49 | 873064 | 881441 | 889549 | 897387 | 904951 | 912239 | 919250 | 925980 | 932429 | 938593 | 11 |
| 50 | 873206 | 881578 | 889682 | 897515 | 905075 | 912358 | 919364 | 926090 | 932534 | 938694 | 10 |
| 51 | 873347 | 881716 | 889815 | 897643 | 905198 | 912477 | 919479 | 926200 | 932639 | 938794 | 9 |
| 52 | 873489 | 881853 | 889948 | 897771 | 905322 | 912596 | 919593 | 926310 | 932744 | 938894 | 8 |
| 53 | 873631 | 881990 | 890080 | 897900 | 905445 | 912715 | 919707 | 926419 | 932849 | 938994 | 7 |
| 54 | 873772 | 882127 | 890213 | 898028 | 905569 | 912834 | 919821 | 926529 | 932954 | 939094 | 6 |
| 55 | 873914 | 882264 | 890345 | 898156 | 905692 | 912953 | 919936 | 926638 | 933058 | 939194 | 5 |
| 56 | 874055 | 882401 | 890478 | 898283 | 905815 | 913072 | 920050 | 926747 | 933163 | 939294 | 4 |
| 57 | 874196 | 882538 | 890610 | 898411 | 905939 | 913190 | 920164 | 926857 | 933267 | 939394 | 3 |
| 58 | 874338 | 882674 | 890742 | 898539 | 906062 | 913309 | 920277 | 926966 | 933372 | 939493 | 2 |
| 59 | 874479 | 882811 | 890874 | 898666 | 906185 | 913427 | 920391 | 927075 | 933476 | 939593 | 1 |
| 60 | 874620 | 882948 | 891007 | 898794 | 906308 | 913545 | 920505 | 927184 | 933580 | 939693 | 0 |
| M | 29° | 28° | 27° | 26° | 25° | 24° | 23° | 22° | 21° | 20° | M |

Natural Co-sines.

| Diff. ) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

Digitized by Google

| M | 70° | 71° | 72° | 73° | 74° | 75° | 76° | 77° | 78° | 79° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 939693 | 945519 | 951057 | 956305 | 961262 | 965926 | 970296 | 974370 | 978148 | 981627 | 60 |
| 1 | 939792 | 945618 | 951146 | 956390 | 961342 | 966001 | 970366 | 974435 | 978208 | 981683 | 59 |
| 2 | 939891 | 945708 | 951236 | 956475 | 961422 | 966076 | 970436 | 974501 | 978268 | 981738 | 58 |
| 3 | 939991 | 945802 | 951326 | 956560 | 961502 | 966151 | 970506 | 974566 | 978329 | 981793 | 57 |
| 4 | 940090 | 945897 | 951415 | 956644 | 961582 | 966226 | 970577 | 974631 | 978389 | 981849 | 56 |
| 5 | 940189 | 945991 | 951505 | 956729 | 961662 | 966301 | 970647 | 974696 | 978449 | 981904 | 55 |
| 6 | 940288 | 946085 | 951594 | 956814 | 961741 | 966376 | 970716 | 974761 | 978509 | 981959 | 54 |
| 7 | 940387 | 946180 | 951684 | 956898 | 961821 | 966451 | 970786 | 974826 | 978569 | 982014 | 53 |
| 8 | 940486 | 946274 | 951773 | 956983 | 961901 | 966526 | 970856 | 974891 | 978629 | 982069 | 52 |
| 9 | 940585 | 946368 | 951862 | 957067 | 961980 | 966600 | 970926 | 974956 | 978689 | 982123 | 51 |
| 10 | 940684 | 946462 | 951951 | 957151 | 962059 | 966675 | 970995 | 975020 | 978748 | 982178 | 50 |
| 11 | 940782 | 946555 | 952040 | 957235 | 962139 | 966749 | 971065 | 975085 | 978808 | 982233 | 49 |
| 12 | 940881 | 946649 | 952129 | 957319 | 962218 | 966823 | 971134 | 975149 | 978867 | 982287 | 48 |
| 13 | 940979 | 946743 | 952218 | 957404 | 962297 | 966898 | 971204 | 975214 | 978927 | 982342 | 47 |
| 14 | 941078 | 946837 | 952307 | 957487 | 962376 | 966972 | 971273 | 975278 | 978986 | 982396 | 46 |
| 15 | 941176 | 946930 | 952396 | 957571 | 962455 | 967046 | 971342 | 975342 | 979045 | 982450 | 45 |
| 16 | 941274 | 947024 | 952484 | 957655 | 962534 | 967120 | 971411 | 975406 | 979105 | 982505 | 44 |
| 17 | 941372 | 947117 | 952573 | 957739 | 962613 | 967194 | 971480 | 975471 | 979164 | 982559 | 43 |
| 18 | 941471 | 947210 | 952661 | 957822 | 962692 | 967268 | 971549 | 975535 | 979223 | 982613 | 42 |
| 19 | 941569 | 947304 | 952750 | 957906 | 962770 | 967342 | 971618 | 975598 | 979282 | 982667 | 41 |
| 20 | 941666 | 947397 | 952838 | 957990 | 962849 | 967415 | 971687 | 975662 | 979341 | 982721 | 40 |
| 21 | 941764 | 947490 | 952926 | 958073 | 962928 | 967489 | 971755 | 975726 | 979399 | 982774 | 39 |
| 22 | 941862 | 947583 | 953015 | 958156 | 963006 | 967562 | 971824 | 975790 | 979458 | 982828 | 38 |
| 23 | 941960 | 947676 | 953103 | 958239 | 963084 | 967636 | 971893 | 975853 | 979517 | 982882 | 37 |
| 24 | 942057 | 947768 | 953191 | 958323 | 963163 | 967709 | 971961 | 975917 | 979575 | 982935 | 36 |
| 25 | 942155 | 947861 | 953279 | 958406 | 963241 | 967782 | 972030 | 975980 | 979634 | 982989 | 35 |
| 26 | 942252 | 947954 | 953366 | 958489 | 963319 | 967856 | 972098 | 976044 | 979692 | 983042 | 34 |
| 27 | 942350 | 948046 | 953454 | 958572 | 963397 | 967929 | 972166 | 976107 | 979750 | 983096 | 33 |
| 28 | 942447 | 948139 | 953542 | 958654 | 963475 | 968002 | 972234 | 976170 | 979809 | 983149 | 32 |
| 29 | 942544 | 948231 | 953629 | 958737 | 963553 | 968075 | 972302 | 976233 | 979867 | 983202 | 31 |
| 30 | 942641 | 948324 | 953717 | 958820 | 963630 | 968148 | 972370 | 976296 | 979925 | 983255 | 30 |
| 31 | 942739 | 948416 | 953804 | 958902 | 963708 | 968220 | 972438 | 976359 | 979983 | 983308 | 29 |
| 32 | 942836 | 948508 | 953892 | 958985 | 963786 | 968293 | 972506 | 976422 | 980041 | 983361 | 28 |
| 33 | 942932 | 948600 | 953979 | 959067 | 963863 | 968366 | 972573 | 976485 | 980098 | 983414 | 27 |
| 34 | 943029 | 948692 | 954066 | 959150 | 963941 | 968438 | 972641 | 976547 | 980156 | 983466 | 26 |
| 35 | 943126 | 948784 | 954153 | 959232 | 964018 | 968511 | 972708 | 976610 | 980214 | 983519 | 25 |
| 36 | 943223 | 948876 | 954240 | 959314 | 964095 | 968583 | 972776 | 976672 | 980271 | 983571 | 24 |
| 37 | 943319 | 948968 | 954327 | 959396 | 964173 | 968656 | 972843 | 976735 | 980329 | 983624 | 23 |
| 38 | 943416 | 949059 | 954414 | 959478 | 964250 | 968728 | 972911 | 976797 | 980386 | 983676 | 22 |
| 39 | 943512 | 949151 | 954501 | 959560 | 964327 | 968800 | 972978 | 976859 | 980443 | 983729 | 21 |
| 40 | 943609 | 949243 | 954588 | 959642 | 964404 | 968872 | 973045 | 976921 | 980500 | 983781 | 20 |
| 41 | 943705 | 949334 | 954674 | 959724 | 964481 | 968944 | 973112 | 976984 | 980558 | 983833 | 19 |
| 42 | 943801 | 949425 | 954761 | 959805 | 964557 | 969016 | 973179 | 977046 | 980615 | 983885 | 18 |
| 43 | 943897 | 949517 | 954847 | 959887 | 964634 | 969088 | 973246 | 977108 | 980672 | 983937 | 17 |
| 44 | 943993 | 949608 | 954934 | 959968 | 964711 | 969159 | 973313 | 977169 | 980728 | 983989 | 16 |
| 45 | 944089 | 949699 | 955020 | 960050 | 964787 | 969231 | 973379 | 977231 | 980785 | 984041 | 15 |
| 46 | 944185 | 949790 | 955106 | 960131 | 964864 | 969302 | 973446 | 977293 | 980842 | 984092 | 14 |
| 47 | 944281 | 949881 | 955192 | 960212 | 964940 | 969374 | 973512 | 977354 | 980899 | 984144 | 13 |
| 48 | 944376 | 949972 | 955278 | 960294 | 965016 | 969445 | 973579 | 977416 | 980955 | 984196 | 12 |
| 49 | 944472 | 950063 | 955364 | 960375 | 965093 | 969517 | 973645 | 977477 | 981012 | 984247 | 11 |
| 50 | 944568 | 950154 | 955450 | 960456 | 965169 | 969588 | 973712 | 977539 | 981068 | 984298 | 10 |
| 51 | 944663 | 950244 | 955536 | 960537 | 965245 | 969659 | 973778 | 977600 | 981124 | 984350 | 9 |
| 52 | 944758 | 950335 | 955622 | 960618 | 965321 | 969730 | 973844 | 977661 | 981181 | 984401 | 8 |
| 53 | 944854 | 950425 | 955707 | 960698 | 965397 | 969801 | 973910 | 977722 | 981237 | 984452 | 7 |
| 54 | 944949 | 950516 | 955793 | 960779 | 965473 | 969872 | 973976 | 977783 | 981293 | 984503 | 6 |
| 55 | 945044 | 950606 | 955879 | 960860 | 965548 | 969943 | 974042 | 977844 | 981349 | 984554 | 5 |
| 56 | 945139 | 950696 | 955964 | 960940 | 965624 | 970014 | 974108 | 977905 | 981405 | 984605 | 4 |
| 57 | 945234 | 950786 | 956049 | 961021 | 965700 | 970084 | 974173 | 977966 | 981460 | 984656 | 3 |
| 58 | 945329 | 950877 | 956134 | 961101 | 965775 | 970155 | 974239 | 978026 | 981516 | 984707 | 2 |
| 59 | 945424 | 950967 | 956220 | 961181 | 965850 | 970225 | 974305 | 978087 | 981572 | 984757 | 1 |
| 60 | 945519 | 951057 | 956305 | 961262 | 965926 | 970296 | 974370 | 978148 | 981627 | 984808 | 0 |
| M | 19° | 18° | 17° | 16° | 15° | 14° | 13° | 12° | 11° | 10° | M |

Natural Co-sines.

| Diff. to 100″ | 162 | 154 | 146 | 138 | 130 | 121 | 113 | 105 | 97 | 88 |
|---|---|---|---|---|---|---|---|---|---|---|

| M | 80° | 81° | 82° | 83° | 84° | 85° | 86° | 87° | 88° | 89° | M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 984808 | 987688 | 990268 | 992546 | 994522 | 996195 | 997564 | 998630 | 999391 | 999848 | 60 |
| 1 | 984858 | 987734 | 990309 | 992582 | 994552 | 996220 | 997584 | 998645 | 999401 | 999853 | 59 |
| 2 | 984909 | 987779 | 990349 | 992617 | 994583 | 996245 | 997604 | 998660 | 999411 | 999858 | 58 |
| 3 | 984959 | 987824 | 990389 | 992652 | 994613 | 996270 | 997625 | 998675 | 999421 | 999863 | 57 |
| 4 | 985009 | 987870 | 990429 | 992687 | 994643 | 996295 | 997645 | 998690 | 999431 | 999867 | 56 |
| 5 | 985059 | 987915 | 990469 | 992722 | 994673 | 996320 | 997664 | 998705 | 999441 | 999872 | 55 |
| 6 | 985109 | 987960 | 990509 | 992757 | 994703 | 996345 | 997684 | 998719 | 999450 | 999877 | 54 |
| 7 | 985159 | 988005 | 990549 | 992792 | 994733 | 996370 | 997704 | 998734 | 999460 | 999881 | 53 |
| 8 | 985209 | 988050 | 990589 | 992827 | 994762 | 996395 | 997724 | 998749 | 999469 | 999886 | 52 |
| 9 | 985259 | 988094 | 990629 | 992862 | 994792 | 996419 | 997743 | 998763 | 999479 | 999890 | 51 |
| 10 | 985309 | 988139 | 990669 | 992896 | 994822 | 996444 | 997763 | 998778 | 999488 | 999894 | 50 |
| 11 | 985358 | 988184 | 990708 | 992931 | 994851 | 996468 | 997782 | 998792 | 999497 | 999898 | 49 |
| 12 | 985408 | 988228 | 990748 | 992966 | 994881 | 996493 | 997801 | 998806 | 999507 | 999903 | 48 |
| 13 | 985457 | 988273 | 990787 | 993000 | 994910 | 996517 | 997821 | 998820 | 999516 | 999907 | 47 |
| 14 | 985507 | 988317 | 990827 | 993034 | 994939 | 996541 | 997840 | 998834 | 999525 | 999910 | 46 |
| 15 | 985556 | 988362 | 990866 | 993068 | 994969 | 996566 | 997859 | 998848 | 999534 | 999914 | 45 |
| 16 | 985605 | 988406 | 990905 | 993103 | 994998 | 996589 | 997878 | 998862 | 999542 | 999918 | 44 |
| 17 | 985654 | 988450 | 990944 | 993137 | 995027 | 996614 | 997897 | 998876 | 999551 | 999922 | 43 |
| 18 | 985703 | 988494 | 990983 | 993171 | 995056 | 996637 | 997916 | 998890 | 999560 | 999925 | 42 |
| 19 | 985752 | 988538 | 991022 | 993205 | 995084 | 996661 | 997934 | 998904 | 999568 | 999929 | 41 |
| 20 | 985801 | 988582 | 991061 | 993238 | 995113 | 996685 | 997953 | 998917 | 999577 | 999932 | 40 |
| 21 | 985850 | 988626 | 991100 | 993272 | 995142 | 996709 | 997972 | 998931 | 999585 | 999936 | 39 |
| 22 | 985899 | 988669 | 991138 | 993306 | 995170 | 996732 | 997990 | 998944 | 999594 | 999939 | 38 |
| 23 | 985947 | 988713 | 991177 | 993339 | 995199 | 996756 | 998008 | 998957 | 999602 | 999942 | 37 |
| 24 | 985996 | 988756 | 991216 | 993373 | 995227 | 996779 | 998027 | 998971 | 999610 | 999945 | 36 |
| 25 | 986045 | 988800 | 991254 | 993406 | 995256 | 996802 | 998045 | 998984 | 999618 | 999948 | 35 |
| 26 | 986093 | 988843 | 991292 | 993439 | 995284 | 996825 | 998063 | 998997 | 999626 | 999951 | 34 |
| 27 | 986141 | 988886 | 991331 | 993473 | 995312 | 996848 | 998081 | 999010 | 999634 | 999954 | 33 |
| 28 | 986189 | 988930 | 991369 | 993506 | 995340 | 996872 | 998099 | 999023 | 999642 | 999957 | 32 |
| 29 | 986238 | 988973 | 991407 | 993539 | 995368 | 996894 | 998117 | 999035 | 999650 | 999959 | 31 |
| 30 | 986286 | 989016 | 991445 | 993572 | 995396 | 996917 | 998135 | 999048 | 999657 | 999962 | 30 |
| 31 | 986334 | 989059 | 991483 | 993605 | 995424 | 996940 | 998153 | 999061 | 999665 | 999964 | 29 |
| 32 | 986381 | 989102 | 991521 | 993638 | 995452 | 996963 | 998170 | 999073 | 999672 | 999967 | 28 |
| 33 | 986429 | 989145 | 991558 | 993670 | 995479 | 996985 | 998188 | 999086 | 999680 | 999969 | 27 |
| 34 | 986477 | 989187 | 991596 | 993703 | 995507 | 997008 | 998205 | 999098 | 999687 | 999971 | 26 |
| 35 | 986525 | 989230 | 991634 | 993735 | 995535 | 997030 | 998223 | 999111 | 999694 | 999974 | 25 |
| 36 | 986572 | 989272 | 991671 | 993768 | 995562 | 997053 | 998240 | 999123 | 999701 | 999976 | 24 |
| 37 | 986620 | 989315 | 991709 | 993800 | 995589 | 997075 | 998257 | 999135 | 999709 | 999978 | 23 |
| 38 | 986667 | 989357 | 991746 | 993833 | 995617 | 997097 | 998274 | 999147 | 999716 | 999980 | 22 |
| 39 | 986714 | 989399 | 991783 | 993865 | 995644 | 997119 | 998291 | 999159 | 999722 | 999981 | 21 |
| 40 | 986762 | 989442 | 991820 | 993897 | 995671 | 997141 | 998308 | 999171 | 999729 | 999983 | 20 |
| 41 | 986809 | 989484 | 991857 | 993929 | 995698 | 997163 | 998325 | 999183 | 999736 | 999985 | 19 |
| 42 | 986856 | 989526 | 991894 | 993961 | 995725 | 997185 | 998342 | 999194 | 999743 | 999986 | 18 |
| 43 | 986903 | 989568 | 991931 | 993993 | 995752 | 997207 | 998359 | 999206 | 999749 | 999988 | 17 |
| 44 | 986950 | 989610 | 991968 | 994025 | 995778 | 997229 | 998375 | 999218 | 999756 | 999989 | 16 |
| 45 | 986996 | 989651 | 992005 | 994056 | 995805 | 997250 | 998392 | 999229 | 999762 | 999990 | 15 |
| 46 | 987043 | 989693 | 992042 | 994088 | 995832 | 997272 | 998408 | 999240 | 999768 | 999992 | 14 |
| 47 | 987090 | 989735 | 992078 | 994120 | 995858 | 997293 | 998425 | 999252 | 999775 | 999993 | 13 |
| 48 | 987136 | 989776 | 992115 | 994151 | 995884 | 997314 | 998441 | 999263 | 999781 | 999994 | 12 |
| 49 | 987183 | 989818 | 992151 | 994182 | 995911 | 997336 | 998457 | 999274 | 999787 | 999995 | 11 |
| 50 | 987229 | 989859 | 992187 | 994214 | 995937 | 997357 | 998473 | 999285 | 999793 | 999996 | 10 |
| 51 | 987275 | 989900 | 992224 | 994245 | 995963 | 997378 | 998489 | 999296 | 999799 | 999997 | 9 |
| 52 | 987322 | 989942 | 992260 | 994276 | 995989 | 997399 | 998505 | 999307 | 999804 | 999997 | 8 |
| 53 | 987368 | 989983 | 992296 | 994307 | 996015 | 997420 | 998521 | 999318 | 999810 | 999998 | 7 |
| 54 | 987414 | 990024 | 992332 | 994338 | 996041 | 997441 | 998537 | 999328 | 999816 | 999998 | 6 |
| 55 | 987460 | 990065 | 992368 | 994369 | 996067 | 997462 | 998552 | 999339 | 999821 | 999999 | 5 |
| 56 | 987506 | 990105 | 992404 | 994400 | 996093 | 997482 | 998568 | 999350 | 999827 | 999999 | 4 |
| 57 | 987551 | 990146 | 992439 | 994430 | 996118 | 997503 | 998583 | 999360 | 999832 | 1000000 | 3 |
| 58 | 987597 | 990187 | 992475 | 994461 | 996144 | 997523 | 998599 | 999370 | 999837 | 1000000 | 2 |
| 59 | 987643 | 990228 | 992511 | 994491 | 996169 | 997544 | 998614 | 999381 | 999843 | 1000000 | 1 |
| 60 | 987688 | 990268 | 992546 | 994522 | 996195 | 997564 | 998630 | 999391 | 999848 | 1000000 | 0 |
| M | 9° | 8° | 7° | 6° | 5° | 4° | 3° | 2° | 1° | 0° | M |

Natural Co-sines.

| Diff. to 100″ | 80 | 72 | 63 | 55 | 47 | 38 | 30 | 21 | 13 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|

# TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## HALF ELAPSED TIME.

### 0 Hour.

| M | 0ᵐ | 5ᵐ | 10ᵐ | 15ᵐ | 20ᵐ | 25ᵐ | 30ᵐ | 35ᵐ | 40ᵐ | 45ᵐ | 50ᵐ | 55ᵐ | Pro. pts. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 43930 | 13833 | 96224 | 83730 | 74039 | 66121 | 59427 | 53628 | 48512 | 43937 | 39797 | | |
| 1 | 2.36018 | 32542 | 29324 | 26328 | 23525 | 20892 | 18410 | 16061 | 13834 | 11715 | 09695 | 07764 | | |
| 2 | 05916 | 04143 | 02440 | 00801 | 99221 | 97697 | 96225 | 94801 | 93422 | 92086 | 90790 | 89531 | | |
| 3 | 1.88307 | 87118 | 85959 | 84831 | 83732 | 82660 | 81613 | 80591 | 79593 | 78617 | 77663 | 76729 | | |
| 4 | 75815 | 74919 | 74042 | 73182 | 72339 | 71512 | 70700 | 69903 | 69121 | 68352 | 67597 | 66855 | | |
| 5 | 1.66125 | 65407 | 64701 | 64006 | 63322 | 62649 | 61986 | 61333 | 60690 | 60056 | 59431 | 58815 | | |
| 6 | 58208 | 57609 | 57019 | 56436 | 55861 | 55293 | 54733 | 54180 | 53634 | 53094 | 52561 | 52035 | | |
| 7 | 51515 | 51001 | 50494 | 49992 | 49496 | 49005 | 48520 | 48040 | 47566 | 47096 | 46632 | 46173 | | |
| 8 | 45718 | 45268 | 44823 | 44382 | 43946 | 43514 | 43086 | 42663 | 42243 | 41828 | 41417 | 41009 | | |
| 9 | 40605 | 40205 | 39809 | 39416 | 39027 | 38641 | 38258 | 37879 | 37504 | 37131 | 36762 | 36395 | | |
| 10 | 1.36032 | 35672 | 35315 | 34960 | 34609 | 34260 | 33915 | 33572 | 33231 | 32893 | 32558 | 32226 | s | |
| 11 | 31896 | 31568 | 31243 | 30921 | 30600 | 30282 | 29967 | 29653 | 29342 | 29034 | 28727 | 28422 | 1 | 60 |
| 12 | 28120 | 27820 | 27522 | 27225 | 26931 | 26639 | 26349 | 26061 | 25774 | 25490 | 25207 | 24926 | 2 | 120 |
| 13 | 24647 | 24370 | 24095 | 23821 | 23549 | 23279 | 23010 | 22743 | 22478 | 22214 | 21952 | 21691 | 3 | 180 |
| 14 | 21433 | 21175 | 20919 | 20665 | 20412 | 20160 | 19910 | 19662 | 19415 | 19169 | 18925 | 18682 | 4 | 240 |
| 15 | 1.18440 | 18200 | 17961 | 17723 | 17487 | 17252 | 17018 | 16786 | 16554 | 16324 | 16096 | 15868 | s | |
| 16 | 15642 | 15416 | 15192 | 14969 | 14748 | 14527 | 14307 | 14089 | 13872 | 13656 | 13440 | 13226 | 1 | 42 |
| 17 | 13013 | 12801 | 12590 | 12380 | 12172 | 11964 | 11757 | 11551 | 11346 | 11142 | 10939 | 10737 | 2 | 84 |
| 18 | 10536 | 10236 | 10136 | 09938 | 09741 | 09544 | 09348 | 09154 | 08960 | 08767 | 08574 | 08383 | 3 | 126 |
| 19 | 08193 | 08003 | 07814 | 07626 | 07439 | 07253 | 07067 | 06883 | 06699 | 06515 | 06333 | 06151 | 4 | 168 |
| 20 | 1.05970 | 05790 | 05611 | 05432 | 05254 | 05077 | 04901 | 04725 | 04550 | 04376 | 04202 | 04029 | s | |
| 21 | 03857 | 03686 | 03515 | 03345 | 03175 | 03006 | 02838 | 02671 | 02504 | 02338 | 02172 | 02007 | 1 | 32 |
| 22 | 01843 | 01679 | 01516 | 01354 | 01192 | 01030 | 00870 | 00710 | 00550 | 00392 | 00233 | 00076 | 2 | 65 |
| 23 | 0.99918 | 99762 | 99606 | 99451 | 99296 | 99141 | 98988 | 98834 | 98682 | 98530 | 98378 | 98227 | 3 | 97 |
| 24 | 98077 | 97927 | 97777 | 97628 | 97480 | 97332 | 97184 | 97038 | 96891 | 96745 | 96600 | 96455 | 4 | 130 |
| 25 | 0.96310 | 96167 | 96023 | 95880 | 95738 | 95596 | 95454 | 95313 | 95172 | 95032 | 94892 | 94753 | s | |
| 26 | 94614 | 94476 | 94338 | 94200 | 94063 | 93927 | 93791 | 93655 | 93519 | 93385 | 93250 | 93116 | 1 | 26 |
| 27 | 92982 | 92849 | 92716 | 92584 | 92452 | 92320 | 92189 | 92059 | 91928 | 91798 | 91669 | 91539 | 2 | 53 |
| 28 | 91411 | 91282 | 91154 | 91027 | 90899 | 90772 | 90646 | 90520 | 90394 | 90268 | 90143 | 90019 | 3 | 79 |
| 29 | 89894 | 89771 | 89647 | 89524 | 89401 | 89278 | 89156 | 89034 | 88913 | 88792 | 88671 | 88550 | 4 | 106 |
| 30 | 0.88430 | 88311 | 88191 | 88072 | 87953 | 87835 | 87717 | 87599 | 87481 | 87364 | 87247 | 87131 | s | |
| 31 | 87015 | 86899 | 86783 | 86668 | 86553 | 86438 | 86324 | 86210 | 86096 | 85983 | 85870 | 85757 | 1 | 22 |
| 32 | 85645 | 85532 | 85420 | 85309 | 85197 | 85086 | 84976 | 84865 | 84755 | 84645 | 84535 | 84426 | 2 | 44 |
| 33 | 84317 | 84208 | 84100 | 83992 | 83884 | 83776 | 83669 | 83561 | 83455 | 83348 | 83242 | 83136 | 3 | 67 |
| 34 | 83030 | 82924 | 82819 | 82714 | 82609 | 82505 | 82401 | 82297 | 82193 | 82089 | 81986 | 81883 | 4 | 89 |
| 35 | 0.81780 | 81678 | 81576 | 81474 | 81372 | 81271 | 81169 | 81068 | 80968 | 80867 | 80767 | 80667 | s | |
| 36 | 80567 | 80467 | 80368 | 80269 | 80170 | 80071 | 79973 | 79875 | 79777 | 79679 | 79581 | 79484 | 1 | 19 |
| 37 | 79387 | 79290 | 79193 | 79097 | 79001 | 78905 | 78809 | 78714 | 78618 | 78523 | 78428 | 78334 | 2 | 38 |
| 38 | 78239 | 78145 | 78051 | 77957 | 77863 | 77770 | 77677 | 77584 | 77491 | 77398 | 77306 | 77214 | 3 | 57 |
| 39 | 77122 | 77030 | 76938 | 76847 | 76756 | 76665 | 76574 | 76483 | 76393 | 76303 | 76213 | 76123 | 4 | 77 |
| 40 | 0.76033 | 75944 | 75854 | 75765 | 75676 | 75588 | 75499 | 75411 | 75323 | 75235 | 75147 | 75059 | s | |
| 41 | 74972 | 74885 | 74798 | 74711 | 74624 | 74537 | 74451 | 74365 | 74279 | 74193 | 74108 | 74022 | 1 | 17 |
| 42 | 73937 | 73852 | 73767 | 73682 | 73597 | 73513 | 73429 | 73345 | 73261 | 73177 | 73093 | 73010 | 2 | 34 |
| 43 | 72927 | 72843 | 72761 | 72678 | 72595 | 72513 | 72430 | 72348 | 72266 | 72185 | 72103 | 72021 | 3 | 51 |
| 44 | 71940 | 71859 | 71778 | 71697 | 71616 | 71536 | 71456 | 71375 | 71295 | 71215 | 71136 | 71056 | 4 | 68 |
| 45 | 0.70976 | 70897 | 70818 | 70739 | 70660 | 70581 | 70503 | 70424 | 70346 | 70268 | 70190 | 70112 | s | |
| 46 | 70035 | 69957 | 69880 | 69802 | 69725 | 69648 | 69571 | 69495 | 69418 | 69342 | 69265 | 69189 | 1 | 15 |
| 47 | 69113 | 69038 | 68962 | 68886 | 68811 | 68735 | 68660 | 68585 | 68510 | 68436 | 68361 | 68287 | 2 | 30 |
| 48 | 68212 | 68138 | 68064 | 67990 | 67916 | 67842 | 67769 | 67695 | 67622 | 67549 | 67476 | 67403 | 3 | 45 |
| 49 | 67330 | 67257 | 67185 | 67112 | 67040 | 66968 | 66896 | 66824 | 66752 | 66681 | 66609 | 66538 | 4 | 60 |
| 50 | 0.66466 | 66395 | 66324 | 66253 | 66182 | 66112 | 66041 | 65971 | 65900 | 65830 | 65760 | 65690 | s | |
| 51 | 65620 | 65551 | 65481 | 65411 | 65342 | 65273 | 65204 | 65135 | 65066 | 64997 | 64928 | 64860 | 1 | 14 |
| 52 | 64791 | 64723 | 64655 | 64587 | 64519 | 64451 | 64383 | 64315 | 64248 | 64180 | 64113 | 64046 | 2 | 27 |
| 53 | 63979 | 63912 | 63845 | 63778 | 63711 | 63645 | 63578 | 63512 | 63445 | 63379 | 63313 | 63247 | 3 | 41 |
| 54 | 63182 | 63116 | 63050 | 62985 | 62919 | 62854 | 62789 | 62724 | 62659 | 62594 | 62529 | 62464 | 4 | 54 |
| 55 | 0.62400 | 62335 | 62271 | 62207 | 62142 | 62078 | 62014 | 61950 | 61887 | 61823 | 61759 | 61696 | s | |
| 56 | 61633 | 61569 | 61506 | 61443 | 61380 | 61317 | 61254 | 61192 | 61129 | 61066 | 61004 | 60942 | 1 | 12 |
| 57 | 60879 | 60817 | 60755 | 60693 | 60632 | 60570 | 60508 | 60447 | 60385 | 60324 | 60262 | 60201 | 2 | 25 |
| 58 | 60140 | 60079 | 60018 | 59957 | 59897 | 59836 | 59775 | 59715 | 59655 | 59594 | 59534 | 59474 | 3 | 37 |
| 59 | 59414 | 59354 | 59294 | 59234 | 59175 | 59115 | 59056 | 58996 | 58937 | 58878 | 58818 | 58759 | 4 | 50 |

# TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## HALF ELAPSED TIME.

### 1 Hour.

| N | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.58700 | 58642 | 58583 | 58524 | 58465 | 58407 | 58348 | 58290 | 58232 | 58173 | 58115 | 58057 | s |
| 1 | 57999 | 57941 | 57884 | 57826 | 57768 | 57711 | 57653 | 57596 | 57539 | 57481 | 57424 | 57367 | 1 \| 11 |
| 2 | 57310 | 57253 | 57196 | 57140 | 57083 | 57026 | 56970 | 56914 | 56857 | 56801 | 56745 | 56689 | 2 \| 22 |
| 3 | 56633 | 56577 | 56521 | 56465 | 56409 | 56354 | 56298 | 56243 | 56187 | 56132 | 56077 | 56021 | 3 \| 34 |
| 4 | 55966 | 55911 | 55856 | 55801 | 55747 | 55692 | 55637 | 55583 | 55528 | 55474 | 55419 | 55365 | 4 \| 45 |
| 5 | 0.55311 | 55257 | 55203 | 55149 | 55095 | 55041 | 54987 | 54933 | 54880 | 54826 | 54773 | 54719 | s |
| 6 | 54666 | 54613 | 54559 | 54506 | 54453 | 54400 | 54347 | 54294 | 54242 | 54189 | 54136 | 54084 | 1 \| 10 |
| 7 | 54031 | 53979 | 53926 | 53874 | 53822 | 53770 | 53718 | 53666 | 53614 | 53562 | 53510 | 53458 | 2 \| 21 |
| 8 | 53407 | 53355 | 53303 | 53252 | 53200 | 53149 | 53098 | 53047 | 52995 | 52944 | 52893 | 52842 | 3 \| 31 |
| 9 | 52791 | 52741 | 52690 | 52639 | 52589 | 52538 | 52488 | 52437 | 52387 | 52336 | 52286 | 52236 | 4 \| 42 |
| 10 | 0.52186 | 52136 | 52086 | 52036 | 51986 | 51936 | 51887 | 51837 | 51787 | 51738 | 51688 | 51639 | s |
| 11 | 51589 | 51540 | 51491 | 51442 | 51393 | 51344 | 51295 | 51246 | 51197 | 51148 | 51099 | 51050 | 1 \| 10 |
| 12 | 51002 | 50953 | 50905 | 50856 | 50808 | 50760 | 50711 | 50663 | 50615 | 50567 | 50519 | 50471 | 2 \| 19 |
| 13 | 50423 | 50375 | 50327 | 50279 | 50232 | 50184 | 50137 | 50089 | 50042 | 49994 | 49947 | 49900 | 3 \| 29 |
| 14 | 49852 | 49805 | 49758 | 49711 | 49664 | 49617 | 49570 | 49523 | 49477 | 49430 | 49383 | 49337 | 4 \| 38 |
| 15 | 0.49290 | 49244 | 49197 | 49151 | 49104 | 49058 | 49012 | 48966 | 48920 | 48874 | 48828 | 48782 | s |
| 16 | 48736 | 48690 | 48644 | 48599 | 48553 | 48507 | 48462 | 48416 | 48371 | 48325 | 48280 | 48235 | 1 \| 9 |
| 17 | 48189 | 48144 | 48099 | 48054 | 48009 | 47964 | 47919 | 47874 | 47829 | 47785 | 47740 | 47695 | 2 \| 18 |
| 18 | 47651 | 47606 | 47561 | 47517 | 47473 | 47428 | 47384 | 47340 | 47295 | 47251 | 47207 | 47163 | 3 \| 27 |
| 19 | 47119 | 47075 | 47031 | 46987 | 46944 | 46900 | 46856 | 46812 | 46769 | 46725 | 46682 | 46638 | 4 \| 36 |
| 20 | 0.46595 | 46552 | 46508 | 46465 | 46422 | 46379 | 46335 | 46292 | 46249 | 46206 | 46163 | 46121 | s |
| 21 | 46078 | 46035 | 45992 | 45950 | 45907 | 45864 | 45822 | 45779 | 45737 | 45694 | 45652 | 45610 | 1 \| 8 |
| 22 | 45568 | 45525 | 45483 | 45441 | 45399 | 45357 | 45315 | 45273 | 45231 | 45189 | 45147 | 45106 | 2 \| 17 |
| 23 | 45064 | 45022 | 44981 | 44939 | 44898 | 44856 | 44815 | 44773 | 44732 | 44691 | 44650 | 44608 | 3 \| 25 |
| 24 | 44567 | 44526 | 44485 | 44444 | 44403 | 44362 | 44321 | 44280 | 44239 | 44199 | 44158 | 44117 | 4 \| 34 |
| 25 | 0.44077 | 44036 | 43996 | 43955 | 43915 | 43874 | 43834 | 43793 | 43753 | 43713 | 43673 | 43633 | s |
| 26 | 43593 | 43552 | 43512 | 43472 | 43432 | 43393 | 43353 | 43313 | 43273 | 43233 | 43194 | 43154 | 1 \| 8 |
| 27 | 43115 | 43075 | 43035 | 42996 | 42957 | 42917 | 42878 | 42838 | 42799 | 42760 | 42721 | 42682 | 2 \| 16 |
| 28 | 42643 | 42603 | 42564 | 42525 | 42486 | 42448 | 42409 | 42370 | 42331 | 42292 | 42254 | 42215 | 3 \| 24 |
| 29 | 42176 | 42138 | 42099 | 42061 | 42022 | 41984 | 41946 | 41907 | 41869 | 41831 | 41792 | 41754 | 4 \| 32 |
| 30 | 0.41716 | 41678 | 41640 | 41602 | 41561 | 41526 | 41488 | 41450 | 41412 | 41375 | 41337 | 41299 | s |
| 31 | 41261 | 41224 | 41186 | 41149 | 41111 | 41074 | 41036 | 40999 | 40961 | 40924 | 40887 | 40849 | 1 \| 7 |
| 32 | 40812 | 40775 | 40738 | 40701 | 40664 | 40627 | 40590 | 40553 | 40516 | 40479 | 40442 | 40405 | 2 \| 15 |
| 33 | 40369 | 40332 | 40295 | 40258 | 40222 | 40185 | 40149 | 40112 | 40076 | 40039 | 40003 | 39966 | 3 \| 22 |
| 34 | 39930 | 39894 | 39858 | 39821 | 39785 | 39749 | 39713 | 39677 | 39641 | 39605 | 39569 | 39533 | 4 \| 30 |
| 35 | 0.39497 | 39461 | 39425 | 39389 | 39354 | 39318 | 39282 | 39247 | 39211 | 39175 | 39140 | 39104 | s |
| 36 | 39069 | 39033 | 38998 | 38962 | 38927 | 38892 | 38857 | 38821 | 38786 | 38751 | 38716 | 38681 | 1 \| 7 |
| 37 | 38646 | 38611 | 38576 | 38541 | 38506 | 38471 | 38436 | 38401 | 38366 | 38331 | 38297 | 38262 | 2 \| 14 |
| 38 | 38227 | 38193 | 38158 | 38124 | 38089 | 38055 | 38020 | 37986 | 37951 | 37917 | 37883 | 37848 | 3 \| 21 |
| 39 | 37814 | 37780 | 37745 | 37711 | 37677 | 37643 | 37609 | 37575 | 37541 | 37507 | 37473 | 37439 | 4 \| 28 |
| 40 | 0.37405 | 37371 | 37338 | 37304 | 37270 | 37236 | 37203 | 37169 | 37135 | 37102 | 37068 | 37035 | s |
| 41 | 37001 | 36968 | 36934 | 36901 | 36867 | 36834 | 36801 | 36768 | 36734 | 36701 | 36668 | 36635 | 1 \| 7 |
| 42 | 36602 | 36569 | 36535 | 36502 | 36469 | 36436 | 36404 | 36371 | 36338 | 36305 | 36272 | 36239 | 2 \| 13 |
| 43 | 36207 | 36174 | 36141 | 36108 | 36076 | 36043 | 36011 | 35978 | 35946 | 35913 | 35881 | 35848 | 3 \| 20 |
| 44 | 35816 | 35783 | 35751 | 35719 | 35687 | 35654 | 35622 | 35590 | 35558 | 35526 | 35494 | 35462 | 4 \| 26 |
| 45 | 0.35429 | 35397 | 35365 | 35334 | 35302 | 35270 | 35238 | 35206 | 35174 | 35142 | 35111 | 35079 | s |
| 46 | 35047 | 35016 | 34984 | 34952 | 34921 | 34889 | 34858 | 34826 | 34795 | 34763 | 34732 | 34701 | 1 \| 6 |
| 47 | 34669 | 34638 | 34607 | 34575 | 34544 | 34513 | 34482 | 34451 | 34420 | 34388 | 34357 | 34326 | 2 \| 12 |
| 48 | 34295 | 34264 | 34233 | 34203 | 34172 | 34141 | 34110 | 34079 | 34048 | 34018 | 33987 | 33956 | 3 \| 19 |
| 49 | 33925 | 33895 | 33864 | 33834 | 33803 | 33773 | 33742 | 33712 | 33681 | 33651 | 33620 | 33590 | 4 \| 25 |
| 50 | 0.33559 | 33529 | 33499 | 33469 | 33438 | 33408 | 33378 | 33348 | 33318 | 33288 | 33257 | 33227 | s |
| 51 | 33197 | 33167 | 33137 | 33107 | 33078 | 33048 | 33018 | 32988 | 32958 | 32928 | 32899 | 32869 | 1 \| 6 |
| 52 | 32839 | 32809 | 32780 | 32750 | 32721 | 32691 | 32661 | 32632 | 32602 | 32573 | 32543 | 32514 | 2 \| 12 |
| 53 | 32485 | 32455 | 32426 | 32397 | 32367 | 32338 | 32309 | 32280 | 32250 | 32221 | 32192 | 32163 | 3 \| 18 |
| 54 | 32134 | 32105 | 32076 | 32047 | 32018 | 31989 | 31960 | 31931 | 31902 | 31873 | 31844 | 31815 | 4 \| 24 |
| 55 | 0.31787 | 31758 | 31729 | 31700 | 31672 | 31643 | 31614 | 31586 | 31557 | 31529 | 31500 | 31471 | s |
| 56 | 31443 | 31414 | 31386 | 31358 | 31329 | 31301 | 31272 | 31244 | 31216 | 31188 | 31159 | 31131 | 1 \| 6 |
| 57 | 31103 | 31075 | 31046 | 31018 | 30990 | 30962 | 30934 | 30906 | 30878 | 30850 | 30822 | 30794 | 2 \| 12 |
| 58 | 30766 | 30738 | 30710 | 30683 | 30655 | 30627 | 30599 | 30571 | 30544 | 30516 | 30488 | 30461 | 3 \| 17 |
| 59 | 30433 | 30405 | 30378 | 30350 | 30323 | 30295 | 30268 | 30240 | 30213 | 30185 | 30158 | 30130 | 4 \| 23 |

# TABLE XXVII.

## To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

### HALF ELAPSED TIME.

### 2 Hours.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.30103 | 30076 | 30048 | 30021 | 29994 | 29967 | 29939 | 29912 | 29885 | 29858 | 29831 | 29804 | s |
| 1 | 29776 | 29749 | 29722 | 29695 | 29668 | 29641 | 29614 | 29587 | 29561 | 29534 | 29507 | 29480 | 1 \| 5 |
| 2 | 29453 | 29426 | 29400 | 29373 | 29346 | 29319 | 29293 | 29266 | 29239 | 29213 | 29186 | 29160 | 2 \| 10 |
| 3 | 29133 | 29107 | 29080 | 29054 | 29027 | 29001 | 28974 | 28948 | 28921 | 28895 | 28869 | 28842 | 3 \| 16 |
| 4 | 28816 | 28790 | 28764 | 28737 | 28711 | 28685 | 28659 | 28633 | 28607 | 28580 | 28554 | 28528 | 4 \| 21 |
| 5 | 0.28502 | 28476 | 28450 | 28424 | 28398 | 28372 | 28347 | 28321 | 28295 | 28269 | 28243 | 28217 | s |
| 6 | 28192 | 28166 | 28140 | 28114 | 28089 | 28063 | 28037 | 28012 | 27986 | 27960 | 27935 | 27909 | 1 \| 5 |
| 7 | 27884 | 27858 | 27833 | 27807 | 27782 | 27756 | 27731 | 27706 | 27680 | 27655 | 27630 | 27604 | 2 \| 10 |
| 8 | 27579 | 27554 | 27529 | 27503 | 27478 | 27453 | 27428 | 27403 | 27378 | 27352 | 27327 | 27302 | 3 \| 15 |
| 9 | 27277 | 27252 | 27227 | 27202 | 27177 | 27152 | 27127 | 27103 | 27078 | 27053 | 27028 | 27003 | 4 \| 20 |
| 10 | 0.26978 | 26954 | 26929 | 26904 | 26879 | 26855 | 26830 | 26805 | 26781 | 26756 | 26732 | 26707 | s |
| 11 | 26682 | 26658 | 26633 | 26609 | 26584 | 26560 | 26535 | 26511 | 26487 | 26462 | 26438 | 26414 | 1 \| 5 |
| 12 | 26389 | 26365 | 26341 | 26316 | 26292 | 26268 | 26244 | 26219 | 26195 | 26171 | 26147 | 26123 | 2 \| 10 |
| 13 | 26099 | 26075 | 26051 | 26027 | 26003 | 25979 | 25955 | 25931 | 25907 | 25883 | 25859 | 25835 | 3 \| 14 |
| 14 | 25811 | 25787 | 25763 | 25740 | 25716 | 25692 | 25668 | 25645 | 25621 | 25597 | 25573 | 25550 | 4 \| 19 |
| 15 | 0.25526 | 25503 | 25479 | 25455 | 25432 | 25408 | 25385 | 25361 | 25338 | 25314 | 25291 | 25267 | s |
| 16 | 25244 | 25220 | 25197 | 25174 | 25150 | 25127 | 25104 | 25080 | 25057 | 25034 | 25011 | 24987 | 1 \| 5 |
| 17 | 24964 | 24941 | 24918 | 24895 | 24872 | 24849 | 24825 | 24802 | 24779 | 24756 | 24733 | 24710 | 2 \| 9 |
| 18 | 24687 | 24664 | 24641 | 24618 | 24595 | 24573 | 24550 | 24527 | 24504 | 24481 | 24458 | 24436 | 3 \| 14 |
| 19 | 24413 | 24390 | 24367 | 24345 | 24322 | 24299 | 24277 | 24254 | 24231 | 24209 | 24186 | 24163 | 4 \| 18 |
| 20 | 0.24141 | 24118 | 24096 | 24073 | 24051 | 24028 | 24006 | 23983 | 23961 | 23939 | 23916 | 23894 | s |
| 21 | 23872 | 23849 | 23827 | 23805 | 23782 | 23760 | 23738 | 23716 | 23693 | 23671 | 23649 | 23627 | 1 \| 4 |
| 22 | 23605 | 23583 | 23560 | 23538 | 23516 | 23494 | 23472 | 23450 | 23428 | 23406 | 23384 | 23362 | 2 \| 9 |
| 23 | 23340 | 23318 | 23296 | 23274 | 23253 | 23231 | 23209 | 23187 | 23165 | 23143 | 23122 | 23100 | 3 \| 13 |
| 24 | 23078 | 23056 | 23035 | 23013 | 22991 | 22970 | 22948 | 22926 | 22905 | 22883 | 22862 | 22840 | 4 \| 18 |
| 25 | 0.22819 | 22797 | 22776 | 22754 | 22733 | 22711 | 22690 | 22668 | 22647 | 22625 | 22604 | 22583 | s |
| 26 | 22561 | 22540 | 22519 | 22497 | 22476 | 22455 | 22434 | 22412 | 22391 | 22370 | 22349 | 22328 | 1 \| 4 |
| 27 | 22306 | 22285 | 22264 | 22243 | 22222 | 22201 | 22180 | 22159 | 22138 | 22117 | 22096 | 22075 | 2 \| 8 |
| 28 | 22054 | 22033 | 22012 | 21991 | 21970 | 21949 | 21928 | 21907 | 21887 | 21866 | 21845 | 21824 | 3 \| 13 |
| 29 | 21803 | 21783 | 21762 | 21741 | 21720 | 21700 | 21679 | 21658 | 21638 | 21617 | 21597 | 21576 | 4 \| 17 |
| 30 | 0.21555 | 21535 | 21514 | 21494 | 21473 | 21453 | 21432 | 21412 | 21391 | 21371 | 21350 | 21330 | s |
| 31 | 21309 | 21289 | 21269 | 21248 | 21228 | 21208 | 21187 | 21167 | 21147 | 21127 | 21106 | 21086 | 1 \| 4 |
| 32 | 21066 | 21046 | 21025 | 21005 | 20985 | 20965 | 20945 | 20925 | 20905 | 20885 | 20864 | 20844 | 2 \| 8 |
| 33 | 20824 | 20804 | 20784 | 20764 | 20744 | 20724 | 20704 | 20685 | 20665 | 20645 | 20625 | 20605 | 3 \| 12 |
| 34 | 20585 | 20565 | 20545 | 20526 | 20506 | 20486 | 20466 | 20446 | 20427 | 20407 | 20387 | 20368 | 4 \| 16 |
| 35 | 0.20348 | 20328 | 20309 | 20289 | 20269 | 20250 | 20230 | 20211 | 20191 | 20171 | 20152 | 20132 | s |
| 36 | 20113 | 20093 | 20074 | 20054 | 20035 | 20016 | 19996 | 19977 | 19957 | 19938 | 19919 | 19899 | 1 \| 4 |
| 37 | 19880 | 19861 | 19841 | 19822 | 19803 | 19783 | 19764 | 19745 | 19726 | 19707 | 19687 | 19668 | 2 \| 8 |
| 38 | 19649 | 19630 | 19611 | 19592 | 19572 | 19553 | 19534 | 19515 | 19496 | 19477 | 19458 | 19439 | 3 \| 11 |
| 39 | 19420 | 19401 | 19382 | 19363 | 19344 | 19325 | 19306 | 19288 | 19269 | 19250 | 19231 | 19212 | 4 \| 15 |
| 40 | 0.19192 | 19174 | 19156 | 19137 | 19118 | 19099 | 19081 | 19062 | 19043 | 19024 | 19006 | 18987 | s |
| 41 | 18968 | 18950 | 18931 | 18913 | 18894 | 18875 | 18857 | 18838 | 18820 | 18801 | 18783 | 18764 | 1 \| 4 |
| 42 | 18746 | 18727 | 18709 | 18690 | 18672 | 18653 | 18635 | 18617 | 18598 | 18580 | 18561 | 18543 | 2 \| 7 |
| 43 | 18525 | 18506 | 18488 | 18470 | 18452 | 18433 | 18415 | 18397 | 18379 | 18360 | 18342 | 18324 | 3 \| 11 |
| 44 | 18306 | 18288 | 18269 | 18251 | 18233 | 18215 | 18197 | 18179 | 18161 | 18143 | 18125 | 18107 | 4 \| 14 |
| 45 | 0.18089 | 18071 | 18053 | 18035 | 18017 | 17999 | 17981 | 17963 | 17945 | 17927 | 17909 | 17891 | s |
| 46 | 17874 | 17856 | 17838 | 17820 | 17802 | 17785 | 17767 | 17749 | 17731 | 17713 | 17696 | 17678 | 1 \| 4 |
| 47 | 17660 | 17643 | 17625 | 17607 | 17590 | 17572 | 17554 | 17537 | 17519 | 17502 | 17484 | 17467 | 2 \| 7 |
| 48 | 17449 | 17431 | 17414 | 17396 | 17379 | 17361 | 17344 | 17327 | 17309 | 17292 | 17274 | 17257 | 3 \| 11 |
| 49 | 17239 | 17222 | 17205 | 17187 | 17170 | 17153 | 17135 | 17118 | 17101 | 17083 | 17066 | 17049 | 4 \| 14 |
| 50 | 0.17032 | 17014 | 16997 | 16980 | 16963 | 16946 | 16929 | 16911 | 16894 | 16877 | 16860 | 16843 | s |
| 51 | 16826 | 16809 | 16792 | 16775 | 16758 | 16741 | 16724 | 16707 | 16690 | 16673 | 16656 | 16639 | 1 \| 3 |
| 52 | 16622 | 16605 | 16588 | 16571 | 16554 | 16537 | 16520 | 16503 | 16487 | 16470 | 16453 | 16436 | 2 \| 7 |
| 53 | 16419 | 16403 | 16386 | 16369 | 16352 | 16336 | 16319 | 16302 | 16285 | 16269 | 16252 | 16235 | 3 \| 10 |
| 54 | 16219 | 16202 | 16186 | 16169 | 16152 | 16136 | 16119 | 16103 | 16086 | 16070 | 16053 | 16037 | 4 \| 14 |
| 55 | 0.16020 | 16004 | 15987 | 15971 | 15954 | 15938 | 15921 | 15905 | 15888 | 15872 | 15856 | 15839 | s |
| 56 | 15823 | 15807 | 15790 | 15774 | 15758 | 15741 | 15725 | 15709 | 15692 | 15676 | 15660 | 15644 | 1 \| 3 |
| 57 | 15628 | 15611 | 15595 | 15579 | 15563 | 15547 | 15531 | 15514 | 15498 | 15482 | 15466 | 15450 | 2 \| 6 |
| 58 | 15434 | 15418 | 15402 | 15386 | 15370 | 15354 | 15338 | 15322 | 15306 | 15290 | 15274 | 15258 | 3 \| 10 |
| 59 | 15242 | 15226 | 15210 | 15194 | 15178 | 15162 | 15147 | 15131 | 15115 | 15099 | 15083 | 15067 | 4 \| 13 |

# TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## HALF ELAPSED TIME.

### 3 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.15052 | 15036 | 15020 | 15004 | 14988 | 14973 | 14957 | 14941 | 14926 | 14910 | 14894 | 14879 | s | |
| 1 | 14863 | 14847 | 14832 | 14816 | 14800 | 14785 | 14769 | 14754 | 14738 | 14722 | 14707 | 14691 | 1 | 3 |
| 2 | 14676 | 14660 | 14645 | 14629 | 14614 | 14598 | 14583 | 14567 | 14552 | 14537 | 14521 | 14506 | 2 | 6 |
| 3 | 14490 | 14475 | 14460 | 14444 | 14429 | 14414 | 14398 | 14383 | 14368 | 14352 | 14337 | 14322 | 3 | 10 |
| 4 | 14307 | 14291 | 14276 | 14261 | 14246 | 14231 | 14215 | 14200 | 14185 | 14170 | 14155 | 14140 | 4 | 13 |
| 5 | 0.14124 | 14109 | 14094 | 14079 | 14064 | 14049 | 14034 | 14019 | 14004 | 13989 | 13974 | 13959 | s | |
| 6 | 13944 | 13929 | 13914 | 13899 | 13884 | 13869 | 13854 | 13839 | 13824 | 13809 | 13795 | 13780 | 1 | 3 |
| 7 | 13765 | 13750 | 13735 | 13720 | 13705 | 13691 | 13676 | 13661 | 13646 | 13632 | 13617 | 13602 | 2 | 6 |
| 8 | 13587 | 13573 | 13558 | 13543 | 13528 | 13514 | 13499 | 13484 | 13470 | 13455 | 13441 | 13426 | 3 | 9 |
| 9 | 13411 | 13397 | 13382 | 13368 | 13353 | 13339 | 13324 | 13309 | 13295 | 13280 | 13266 | 13251 | 4 | 12 |
| 10 | 0.13237 | 13223 | 13208 | 13194 | 13179 | 13165 | 13150 | 13136 | 13122 | 13107 | 13093 | 13078 | s | |
| 11 | 13064 | 13050 | 13035 | 13021 | 13007 | 12992 | 12978 | 12964 | 12950 | 12935 | 12921 | 12907 | 1 | 3 |
| 12 | 12893 | 12878 | 12864 | 12850 | 12836 | 12822 | 12808 | 12793 | 12779 | 12765 | 12751 | 12737 | 2 | 6 |
| 13 | 12723 | 12709 | 12695 | 12681 | 12667 | 12652 | 12638 | 12624 | 12610 | 12596 | 12582 | 12568 | 3 | 8 |
| 14 | 12554 | 12540 | 12527 | 12513 | 12499 | 12485 | 12471 | 12457 | 12443 | 12429 | 12415 | 12401 | 4 | 11 |
| 15 | 0.12388 | 12374 | 12360 | 12346 | 12332 | 12318 | 12305 | 12291 | 12277 | 12263 | 12250 | 12236 | s | |
| 16 | 12222 | 12208 | 12195 | 12181 | 12167 | 12154 | 12140 | 12126 | 12113 | 12099 | 12085 | 12072 | 1 | 3 |
| 17 | 12058 | 12044 | 12031 | 12017 | 12004 | 11990 | 11977 | 11963 | 11950 | 11936 | 11922 | 11909 | 2 | 5 |
| 18 | 11896 | 11882 | 11869 | 11855 | 11842 | 11828 | 11815 | 11801 | 11788 | 11775 | 11761 | 11748 | 3 | 8 |
| 19 | 11734 | 11721 | 11708 | 11694 | 11681 | 11668 | 11654 | 11641 | 11628 | 11614 | 11601 | 11588 | 4 | 10 |
| 20 | 0.11575 | 11561 | 11548 | 11535 | 11522 | 11509 | 11495 | 11482 | 11469 | 11456 | 11443 | 11429 | s | |
| 21 | 11416 | 11403 | 11390 | 11377 | 11364 | 11351 | 11338 | 11325 | 11312 | 11299 | 11286 | 11272 | 1 | 3 |
| 22 | 11259 | 11246 | 11233 | 11220 | 11207 | 11194 | 11182 | 11169 | 11156 | 11143 | 11130 | 11117 | 2 | 5 |
| 23 | 11104 | 11091 | 11078 | 11065 | 11052 | 11040 | 11027 | 11014 | 11001 | 10988 | 10975 | 10963 | 3 | 8 |
| 24 | 10950 | 10937 | 10924 | 10911 | 10899 | 10886 | 10873 | 10861 | 10848 | 10835 | 10822 | 10810 | 4 | 10 |
| 25 | 0.10797 | 10784 | 10772 | 10759 | 10746 | 10734 | 10721 | 10709 | 10696 | 10683 | 10671 | 10658 | s | |
| 26 | 10646 | 10633 | 10621 | 10608 | 10595 | 10583 | 10570 | 10558 | 10545 | 10533 | 10520 | 10508 | 1 | 2 |
| 27 | 10496 | 10483 | 10471 | 10458 | 10446 | 10433 | 10421 | 10409 | 10396 | 10384 | 10372 | 10359 | 2 | 5 |
| 28 | 10347 | 10335 | 10322 | 10310 | 10298 | 10285 | 10273 | 10261 | 10248 | 10236 | 10224 | 10212 | 3 | 7 |
| 29 | 10199 | 10187 | 10175 | 10163 | 10151 | 10138 | 10126 | 10114 | 10102 | 10090 | 10078 | 10066 | 4 | 10 |
| 30 | 0.10053 | 10041 | 10029 | 10017 | 10005 | 09993 | 09981 | 09969 | 09957 | 09945 | 09933 | 09921 | s | |
| 31 | 09909 | 09897 | 09885 | 09873 | 09861 | 09849 | 09837 | 09825 | 09813 | 09801 | 09789 | 09777 | 1 | 2 |
| 32 | 09765 | 09753 | 09741 | 09730 | 09718 | 09706 | 09694 | 09682 | 09670 | 09658 | 09647 | 09635 | 2 | 5 |
| 33 | 09623 | 09611 | 09599 | 09588 | 09576 | 09564 | 09552 | 09541 | 09529 | 09517 | 09506 | 09494 | 3 | 7 |
| 34 | 09482 | 09471 | 09459 | 09447 | 09436 | 09424 | 09412 | 09401 | 09389 | 09377 | 09366 | 09354 | 4 | 10 |
| 35 | 0.09343 | 09331 | 09319 | 09308 | 09296 | 09285 | 09273 | 09262 | 09250 | 09239 | 09227 | 09216 | s | |
| 36 | 09204 | 09193 | 09181 | 09170 | 09158 | 09147 | 09136 | 09124 | 09113 | 09101 | 09090 | 09079 | 1 | 2 |
| 37 | 09067 | 09056 | 09045 | 09033 | 09022 | 09011 | 08999 | 08988 | 08977 | 08965 | 08954 | 08943 | 2 | 4 |
| 38 | 08931 | 08920 | 08909 | 08898 | 08886 | 08875 | 08864 | 08853 | 08842 | 08830 | 08819 | 08808 | 3 | 7 |
| 39 | 08797 | 08786 | 08775 | 08763 | 08752 | 08741 | 08730 | 08719 | 08708 | 08697 | 08686 | 08675 | 4 | 9 |
| 40 | 0.08664 | 08653 | 08642 | 08630 | 08619 | 08608 | 08597 | 08586 | 08575 | 08564 | 08553 | 08542 | s | |
| 41 | 08532 | 08521 | 08510 | 08499 | 08488 | 08477 | 08466 | 08455 | 08444 | 08433 | 08422 | 08412 | 1 | 2 |
| 42 | 08401 | 08390 | 08379 | 08368 | 08357 | 08347 | 08336 | 08325 | 08314 | 08303 | 08293 | 08282 | 2 | 4 |
| 43 | 08271 | 08260 | 08250 | 08239 | 08228 | 08217 | 08207 | 08196 | 08185 | 08175 | 08164 | 08153 | 3 | 7 |
| 44 | 08143 | 08132 | 08121 | 08111 | 08100 | 08089 | 08079 | 08068 | 08058 | 08047 | 08037 | 08026 | 4 | 9 |
| 45 | 0.08015 | 08005 | 07994 | 07984 | 07973 | 07963 | 07952 | 07942 | 07931 | 07921 | 07910 | 07900 | s | |
| 46 | 07889 | 07879 | 07869 | 07858 | 07848 | 07837 | 07827 | 07816 | 07806 | 07796 | 07785 | 07775 | 1 | 2 |
| 47 | 07765 | 07754 | 07744 | 07734 | 07723 | 07713 | 07703 | 07692 | 07682 | 07672 | 07661 | 07651 | 2 | 4 |
| 48 | 07641 | 07631 | 07620 | 07610 | 07600 | 07590 | 07580 | 07569 | 07559 | 07549 | 07539 | 07529 | 3 | 6 |
| 49 | 07518 | 07508 | 07498 | 07488 | 07478 | 07468 | 07458 | 07448 | 07437 | 07427 | 07417 | 07407 | 4 | 8 |
| 50 | 0.07397 | 07387 | 07377 | 07367 | 07357 | 07347 | 07337 | 07327 | 07317 | 07307 | 07297 | 07287 | s | |
| 51 | 07277 | 07267 | 07257 | 07247 | 07237 | 07227 | 07217 | 07207 | 07198 | 07188 | 07178 | 07168 | 1 | 2 |
| 52 | 07158 | 07148 | 07138 | 07128 | 07119 | 07109 | 07099 | 07089 | 07079 | 07070 | 07060 | 07050 | 2 | 4 |
| 53 | 07040 | 07030 | 07021 | 07011 | 07001 | 06991 | 06982 | 06972 | 06962 | 06953 | 06943 | 06933 | 3 | 6 |
| 54 | 06923 | 06914 | 06904 | 06894 | 06885 | 06875 | 06866 | 06856 | 06846 | 06837 | 06827 | 06818 | 4 | 8 |
| 55 | 0.06808 | 06798 | 06789 | 06779 | 06770 | 06760 | 06751 | 06741 | 06732 | 06722 | 06712 | 06703 | s | |
| 56 | 06693 | 06684 | 06675 | 06665 | 06656 | 06646 | 06637 | 06627 | 06618 | 06608 | 06599 | 06590 | 1 | 2 |
| 57 | 06580 | 06571 | 06561 | 06552 | 06543 | 06533 | 06524 | 06515 | 06505 | 06496 | 06487 | 06477 | 2 | 4 |
| 58 | 06468 | 06459 | 06449 | 06440 | 06431 | 06422 | 06412 | 06403 | 06394 | 06385 | 06375 | 06366 | 3 | 6 |
| 59 | 06357 | 06348 | 06339 | 06329 | 06320 | 06311 | 06302 | 06293 | 06284 | 06274 | 06265 | 06256 | 4 | 8 |

# TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## HALF ELAPSED TIME.

### 4 Hours.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.06247 | 06238 | 06229 | 06220 | 06211 | 06202 | 06192 | 06183 | 06174 | 06165 | 06156 | 06147 | s |
| 1 | 06138 | 06129 | 06120 | 06111 | 06102 | 06093 | 06084 | 06075 | 06066 | 06057 | 06048 | 06039 | 1 \| 2 |
| 2 | 06030 | 06021 | 06013 | 06004 | 05995 | 05986 | 05977 | 05968 | 05959 | 05950 | 05941 | 05933 | 2 \| 4 |
| 3 | 05924 | 05915 | 05906 | 05897 | 05888 | 05880 | 05871 | 05862 | 05853 | 05844 | 05836 | 05827 | 3 \| 5 |
| 4 | 05818 | 05809 | 05801 | 05792 | 05783 | 05774 | 05766 | 05757 | 05748 | 05740 | 05731 | 05722 | 4 \| 7 |
| 5 | 0.05714 | 05705 | 05696 | 05688 | 05679 | 05670 | 05662 | 05653 | 05645 | 05636 | 05627 | 05619 | s |
| 6 | 05610 | 05602 | 05593 | 05585 | 05576 | 05567 | 05559 | 05550 | 05542 | 05533 | 05525 | 05516 | 1 \| 2 |
| 7 | 05508 | 05499 | 05491 | 05482 | 05474 | 05466 | 05457 | 05449 | 05440 | 05432 | 05423 | 05415 | 2 \| 4 |
| 8 | 05407 | 05398 | 05390 | 05381 | 05373 | 05365 | 05356 | 05348 | 05340 | 05331 | 05323 | 05315 | 3 \| 5 |
| 9 | 05306 | 05298 | 05290 | 05281 | 05273 | 05265 | 05257 | 05248 | 05240 | 05232 | 05224 | 05215 | 4 \| 7 |
| 10 | 0.05207 | 05199 | 05191 | 05183 | 05174 | 05166 | 05158 | 05150 | 05142 | 05133 | 05125 | 05117 | s |
| 11 | 05109 | 05101 | 05093 | 05085 | 05077 | 05068 | 05060 | 05052 | 05044 | 05036 | 05028 | 05020 | 1 \| 2 |
| 12 | 05012 | 05004 | 04996 | 04988 | 04980 | 04972 | 04964 | 04956 | 04948 | 04940 | 04932 | 04924 | 2 \| 3 |
| 13 | 04916 | 04908 | 04900 | 04892 | 04884 | 04876 | 04868 | 04860 | 04852 | 04845 | 04837 | 04829 | 3 \| 5 |
| 14 | 04821 | 04813 | 04805 | 04797 | 04790 | 04782 | 04774 | 04766 | 04758 | 04750 | 04743 | 04735 | 4 \| 6 |
| 15 | 0.04727 | 04719 | 04711 | 04704 | 04696 | 04688 | 04680 | 04673 | 04665 | 04657 | 04649 | 04642 | s |
| 16 | 04634 | 04626 | 04619 | 04611 | 04603 | 04596 | 04588 | 04580 | 04573 | 04565 | 04557 | 04550 | 1 \| 2 |
| 17 | 04542 | 04535 | 04527 | 04519 | 04512 | 04504 | 04497 | 04489 | 04481 | 04474 | 04466 | 04459 | 2 \| 3 |
| 18 | 04451 | 04444 | 04436 | 04429 | 04421 | 04414 | 04406 | 04399 | 04391 | 04384 | 04376 | 04369 | 3 \| 5 |
| 19 | 04361 | 04354 | 04346 | 04339 | 04332 | 04324 | 04317 | 04309 | 04302 | 04295 | 04287 | 04280 | 4 \| 6 |
| 20 | 0.04272 | 04265 | 04258 | 04250 | 04243 | 04236 | 04228 | 04221 | 04214 | 04206 | 04199 | 04192 | s |
| 21 | 04185 | 04177 | 04170 | 04163 | 04156 | 04148 | 04141 | 04134 | 04127 | 04119 | 04112 | 04105 | 1 \| 1 |
| 22 | 04098 | 04091 | 04083 | 04076 | 04069 | 04062 | 04055 | 04048 | 04040 | 04033 | 04026 | 04019 | 2 \| 3 |
| 23 | 04012 | 04005 | 03998 | 03991 | 03984 | 03976 | 03969 | 03962 | 03955 | 03948 | 03941 | 03934 | 3 \| 4 |
| 24 | 03927 | 03920 | 03913 | 03906 | 03899 | 03892 | 03885 | 03878 | 03871 | 03864 | 03857 | 03850 | 4 \| 6 |
| 25 | 0.03843 | 03836 | 03829 | 03822 | 03815 | 03809 | 03802 | 03795 | 03788 | 03781 | 03774 | 03767 | s |
| 26 | 03760 | 03753 | 03747 | 03740 | 03733 | 03726 | 03719 | 03712 | 03706 | 03699 | 03692 | 03685 | 1 \| 1 |
| 27 | 03678 | 03672 | 03665 | 03658 | 03651 | 03645 | 03638 | 03631 | 03624 | 03618 | 03611 | 03604 | 2 \| 3 |
| 28 | 03597 | 03591 | 03584 | 03577 | 03571 | 03564 | 03557 | 03551 | 03544 | 03537 | 03531 | 03524 | 3 \| 4 |
| 29 | 03517 | 03511 | 03504 | 03498 | 03491 | 03484 | 03478 | 03471 | 03465 | 03458 | 03452 | 03445 | 4 \| 6 |
| 30 | 0.03439 | 03432 | 03425 | 03419 | 03412 | 03406 | 03399 | 03393 | 03386 | 03380 | 03373 | 03367 | s |
| 31 | 03361 | 03354 | 03348 | 03341 | 03335 | 03328 | 03322 | 03315 | 03309 | 03303 | 03296 | 03290 | 1 \| 1 |
| 32 | 03283 | 03277 | 03271 | 03264 | 03258 | 03252 | 03245 | 03239 | 03233 | 03226 | 03220 | 03214 | 2 \| 2 |
| 33 | 03207 | 03201 | 03195 | 03189 | 03182 | 03176 | 03170 | 03163 | 03157 | 03151 | 03145 | 03138 | 3 \| 4 |
| 34 | 03132 | 03126 | 03120 | 03114 | 03107 | 03101 | 03095 | 03089 | 03083 | 03077 | 03070 | 03064 | 4 \| 5 |
| 35 | 0.03058 | 03052 | 03046 | 03040 | 03034 | 03027 | 03021 | 03015 | 03009 | 03003 | 02997 | 02991 | s |
| 36 | 02985 | 02979 | 02973 | 02967 | 02961 | 02955 | 02949 | 02943 | 02937 | 02931 | 02925 | 02919 | 1 \| 1 |
| 37 | 02913 | 02907 | 02901 | 02895 | 02889 | 02883 | 02877 | 02871 | 02865 | 02859 | 02853 | 02847 | 2 \| 2 |
| 38 | 02841 | 02835 | 02829 | 02824 | 02818 | 02812 | 02806 | 02800 | 02794 | 02788 | 02783 | 02777 | 3 \| 4 |
| 39 | 02771 | 02765 | 02759 | 02753 | 02748 | 02742 | 02736 | 02730 | 02725 | 02719 | 02713 | 02707 | 4 \| 5 |
| 40 | 0.02701 | 02696 | 02690 | 02684 | 02679 | 02673 | 02667 | 02661 | 02656 | 02650 | 02644 | 02639 | s |
| 41 | 02633 | 02627 | 02622 | 02616 | 02610 | 02605 | 02599 | 02593 | 02588 | 02582 | 02577 | 02571 | 1 \| 1 |
| 42 | 02565 | 02560 | 02554 | 02549 | 02543 | 02538 | 02532 | 02526 | 02521 | 02515 | 02510 | 02504 | 2 \| 2 |
| 43 | 02499 | 02493 | 02488 | 02482 | 02477 | 02471 | 02466 | 02460 | 02455 | 02449 | 02444 | 02438 | 3 \| 3 |
| 44 | 02433 | 02428 | 02422 | 02417 | 02411 | 02406 | 02401 | 02395 | 02390 | 02384 | 02379 | 02374 | 4 \| 4 |
| 45 | 0.02368 | 02363 | 02358 | 02352 | 02347 | 02342 | 02336 | 02331 | 02326 | 02320 | 02315 | 02310 | s |
| 46 | 02304 | 02299 | 02294 | 02289 | 02283 | 02278 | 02273 | 02268 | 02262 | 02257 | 02252 | 02247 | 1 \| 1 |
| 47 | 02241 | 02236 | 02231 | 02226 | 02221 | 02215 | 02210 | 02205 | 02200 | 02195 | 02190 | 02185 | 2 \| 2 |
| 48 | 02179 | 02174 | 02169 | 02164 | 02159 | 02154 | 02149 | 02144 | 02139 | 02134 | 02128 | 02123 | 3 \| 3 |
| 49 | 02118 | 02113 | 02108 | 02103 | 02098 | 02093 | 02088 | 02083 | 02078 | 02073 | 02068 | 02063 | 4 \| 4 |
| 50 | 0.02058 | 02053 | 02048 | 02043 | 02038 | 02033 | 02028 | 02023 | 02018 | 02014 | 02009 | 02004 | s |
| 51 | 01999 | 01994 | 01989 | 01984 | 01979 | 01974 | 01970 | 01965 | 01960 | 01955 | 01950 | 01945 | 1 \| 1 |
| 52 | 01940 | 01936 | 01931 | 01926 | 01921 | 01916 | 01912 | 01907 | 01902 | 01897 | 01892 | 01888 | 2 \| 2 |
| 53 | 01883 | 01878 | 01873 | 01869 | 01864 | 01859 | 01855 | 01850 | 01845 | 01840 | 01836 | 01831 | 3 \| 3 |
| 54 | 01826 | 01822 | 01817 | 01812 | 01808 | 01803 | 01798 | 01794 | 01789 | 01785 | 01780 | 01775 | 4 \| 4 |
| 55 | 0.01771 | 01766 | 01761 | 01757 | 01752 | 01748 | 01743 | 01739 | 01734 | 01730 | 01725 | 01720 | s |
| 56 | 01716 | 01711 | 01707 | 01702 | 01698 | 01693 | 01689 | 01684 | 01680 | 01675 | 01671 | 01666 | 1 \| 1 |
| 57 | 01662 | 01658 | 01653 | 01649 | 01644 | 01640 | 01635 | 01631 | 01627 | 01622 | 01618 | 01613 | 2 \| 2 |
| 58 | 01609 | 01605 | 01600 | 01596 | 01592 | 01587 | 01583 | 01578 | 01574 | 01570 | 01566 | 01561 | 3 \| 2 |
| 59 | 01557 | 01553 | 01548 | 01544 | 01540 | 01535 | 01531 | 01527 | 01523 | 01518 | 01514 | 01510 | 4 \| 3 |

# TABLE XXVII.

## To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

### HALF ELAPSED TIME.

### 5 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.01506 | 01501 | 01497 | 01493 | 01489 | 01485 | 01480 | 01476 | 01472 | 01468 | 01464 | 01460 | s |
| 1 | 01455 | 01451 | 01447 | 01443 | 01439 | 01435 | 01431 | 01426 | 01422 | 01418 | 01414 | 01410 | 1 \| 1 |
| 2 | 01406 | 01402 | 01398 | 01394 | 01390 | 01386 | 01382 | 01377 | 01373 | 01369 | 01365 | 01361 | 2 \| 2 |
| 3 | 01357 | 01353 | 01349 | 01345 | 01341 | 01337 | 01333 | 01329 | 01325 | 01321 | 01318 | 01314 | 3 \| 2 |
| 4 | 01310 | 01306 | 01302 | 01298 | 01294 | 01290 | 01286 | 01282 | 01278 | 01274 | 01271 | 01267 | 4 \| 3 |
| 5 | 0.01263 | 01259 | 01255 | 01251 | 01247 | 01244 | 01240 | 01236 | 01232 | 01228 | 01224 | 01221 | s |
| 6 | 01217 | 01213 | 01209 | 01206 | 01202 | 01198 | 01194 | 01191 | 01187 | 01183 | 01179 | 01176 | 1 \| 1 |
| 7 | 01172 | 01168 | 01164 | 01161 | 01157 | 01153 | 01150 | 01146 | 01142 | 01139 | 01135 | 01131 | 2 \| 2 |
| 8 | 01128 | 01124 | 01120 | 01117 | 01113 | 01110 | 01106 | 01102 | 01099 | 01095 | 01092 | 01088 | 3 \| 2 |
| 9 | 01084 | 01081 | 01077 | 01074 | 01070 | 01067 | 01063 | 01059 | 01056 | 01052 | 01049 | 01045 | 4 \| 3 |
| 10 | 0.01042 | 01038 | 01035 | 01031 | 01028 | 01024 | 01021 | 01018 | 01014 | 01011 | 01007 | 01004 | s |
| 11 | 01000 | 00997 | 00993 | 00990 | 00987 | 00983 | 00980 | 00976 | 00973 | 00970 | 00966 | 00963 | 1 \| 1 |
| 12 | 00960 | 00956 | 00953 | 00950 | 00946 | 00943 | 00940 | 00936 | 00933 | 00930 | 00926 | 00923 | 2 \| 1 |
| 13 | 00920 | 00916 | 00913 | 00910 | 00907 | 00903 | 00900 | 00897 | 00894 | 00890 | 00887 | 00884 | 3 \| 2 |
| 14 | 00881 | 00878 | 00874 | 00871 | 00868 | 00865 | 00862 | 00858 | 00855 | 00852 | 00849 | 00846 | 4 \| 2 |
| 15 | 0.00843 | 00840 | 00836 | 00833 | 00830 | 00827 | 00824 | 00821 | 00818 | 00815 | 00812 | 00808 | s |
| 16 | 00805 | 00802 | 00799 | 00796 | 00793 | 00790 | 00787 | 00784 | 00781 | 00778 | 00775 | 00772 | 1 \| 1 |
| 17 | 00769 | 00766 | 00763 | 00760 | 00757 | 00754 | 00751 | 00748 | 00745 | 00742 | 00739 | 00736 | 2 \| 1 |
| 18 | 00733 | 00731 | 00728 | 00725 | 00722 | 00719 | 00716 | 00713 | 00710 | 00707 | 00704 | 00702 | 3 \| 2 |
| 19 | 00699 | 00696 | 00693 | 00690 | 00687 | 00685 | 00682 | 00679 | 00676 | 00673 | 00670 | 00668 | 4 \| 2 |
| 20 | 0.00665 | 00662 | 00659 | 00657 | 00654 | 00651 | 00648 | 00646 | 00643 | 00640 | 00637 | 00635 | s |
| 21 | 00632 | 00629 | 00627 | 00624 | 00621 | 00618 | 00616 | 00613 | 00610 | 00608 | 00605 | 00602 | 1 \| 1 |
| 22 | 00600 | 00597 | 00595 | 00592 | 00589 | 00587 | 00584 | 00581 | 00579 | 00576 | 00574 | 00571 | 2 \| 1 |
| 23 | 00568 | 00566 | 00563 | 00561 | 00558 | 00556 | 00553 | 00551 | 00548 | 00546 | 00543 | 00541 | 3 \| 2 |
| 24 | 00538 | 00536 | 00533 | 00531 | 00528 | 00526 | 00523 | 00521 | 00518 | 00516 | 00513 | 00511 | 4 \| 2 |
| 25 | 0.00508 | 00506 | 00504 | 00501 | 00499 | 00496 | 00494 | 00492 | 00489 | 00487 | 00484 | 00482 | s |
| 26 | 00480 | 00477 | 00475 | 00473 | 00470 | 00468 | 00466 | 00463 | 00461 | 00459 | 00456 | 00454 | 1 \| 0 |
| 27 | 00452 | 00450 | 00447 | 00445 | 00443 | 00440 | 00138 | 00436 | 00434 | 00431 | 00429 | 00427 | 2 \| 1 |
| 28 | 00425 | 00423 | 00420 | 00418 | 00416 | 00414 | 00412 | 00409 | 00107 | 00405 | 00403 | 00401 | 3 \| 1 |
| 29 | 00399 | 00396 | 00394 | 00392 | 00390 | 00388 | 00386 | 00384 | 00382 | 00379 | 00377 | 00375 | 4 \| 2 |
| 30 | 0.00373 | 00371 | 00369 | 00367 | 00365 | 00363 | 00361 | 00359 | 00357 | 00355 | 00353 | 00351 | s |
| 31 | 00349 | 00347 | 00345 | 00343 | 00341 | 00339 | 00337 | 00335 | 00333 | 00331 | 00329 | 00327 | 1 \| 0 |
| 32 | 00325 | 00323 | 00321 | 00319 | 00317 | 00315 | 00313 | 00312 | 00310 | 00308 | 00306 | 00304 | 2 \| 1 |
| 33 | 00302 | 00300 | 00298 | 00297 | 00295 | 00293 | 00291 | 00289 | 00287 | 00286 | 00284 | 00282 | 3 \| 1 |
| 34 | 00280 | 00278 | 00277 | 00275 | 00273 | 00271 | 00269 | 00267 | 00266 | 00264 | 00262 | 00261 | 4 \| 2 |
| 35 | 0.00259 | 00257 | 00256 | 00254 | 00252 | 00250 | 00249 | 00247 | 00245 | 00244 | 00242 | 00240 | s |
| 36 | 00239 | 00237 | 00235 | 00234 | 00232 | 00230 | 00229 | 00227 | 00226 | 00224 | 00222 | 00221 | 1 \| 0 |
| 37 | 00219 | 00218 | 00216 | 00214 | 00213 | 00211 | 00210 | 00208 | 00207 | 00205 | 00204 | 00202 | 2 \| 1 |
| 38 | 00200 | 00199 | 00197 | 00196 | 00194 | 00193 | 00191 | 00190 | 00188 | 00187 | 00186 | 00184 | 3 \| 1 |
| 39 | 00183 | 00181 | 00180 | 00178 | 00177 | 00175 | 00174 | 00173 | 00171 | 00170 | 00168 | 00167 | 4 \| 2 |
| 40 | 0.00166 | 00164 | 00163 | 00162 | 00160 | 00159 | 00157 | 00156 | 00155 | 00153 | 00152 | 00151 | s |
| 41 | 00149 | 00148 | 00147 | 00146 | 00144 | 00143 | 00142 | 00140 | 00139 | 00138 | 00137 | 00135 | 1 \| 0 |
| 42 | 00134 | 00133 | 00132 | 00130 | 00129 | 00128 | 00127 | 00126 | 00124 | 00123 | 00122 | 00121 | 2 \| 0 |
| 43 | 00120 | 00118 | 00117 | 00116 | 00115 | 00114 | 00113 | 00112 | 00110 | 00109 | 00108 | 00107 | 3 \| 1 |
| 44 | 00106 | 00105 | 00104 | 00103 | 00102 | 00101 | 00099 | 00098 | 00097 | 00096 | 00095 | 00094 | 4 \| 1 |
| 45 | 0.00093 | 00092 | 00091 | 00090 | 00089 | 00088 | 00087 | 00086 | 00085 | 00084 | 00083 | 00082 | s |
| 46 | 00081 | 00080 | 00079 | 00078 | 00077 | 00076 | 00075 | 00075 | 00074 | 00073 | 00072 | 00071 | 1 \| 0 |
| 47 | 00070 | 00069 | 00068 | 00067 | 00066 | 00066 | 00065 | 00064 | 00063 | 00062 | 00061 | 00060 | 2 \| 0 |
| 48 | 00060 | 00059 | 00058 | 00057 | 00056 | 00056 | 00055 | 00054 | 00053 | 00052 | 00052 | 00051 | 3 \| 1 |
| 49 | 00050 | 00049 | 00049 | 00048 | 00047 | 00046 | 00046 | 00045 | 00044 | 00044 | 00043 | 00042 | 4 \| 1 |
| 50 | 0.00041 | 00041 | 00040 | 00039 | 00039 | 00038 | 00037 | 00037 | 00036 | 00035 | 00035 | 00034 | s |
| 51 | 00034 | 00033 | 00032 | 00032 | 00031 | 00031 | 00030 | 00029 | 00029 | 00028 | 00028 | 00027 | 1 \| 0 |
| 52 | 00027 | 00026 | 00025 | 00025 | 00024 | 00024 | 00023 | 00023 | 00022 | 00022 | 00021 | 00021 | 2 \| 0 |
| 53 | 00020 | 00020 | 00019 | 00019 | 00018 | 00018 | 00017 | 00017 | 00016 | 00016 | 00016 | 00015 | 3 \| 0 |
| 54 | 00015 | 00015 | 00014 | 00014 | 00013 | 00013 | 00013 | 00012 | 00012 | 00011 | 00011 | 00011 | 4 \| 1 |
| 55 | 0.00010 | 00010 | 00010 | 00009 | 00009 | 00009 | 00008 | 00008 | 00008 | 00008 | 00007 | 00007 | s |
| 56 | 00007 | 00006 | 00006 | 00006 | 00006 | 00005 | 00005 | 00005 | 00005 | 00004 | 00004 | 00004 | 1 \| 0 |
| 57 | 00004 | 00004 | 00003 | 00003 | 00003 | 00003 | 00003 | 00002 | 00002 | 00002 | 00002 | 00002 | 2 \| 0 |
| 58 | 00002 | 00002 | 00001 | 00001 | 00001 | 00001 | 00001 | 00001 | 00001 | 00001 | 00001 | 00001 | 3 \| 0 |
| 59 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 4 \| 1 |

# TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## MIDDLE TIME.

### 0 Hour.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.00000 | 86167 | 16270 | 33879 | 46373 | 56064 | 63982 | 70676 | 76476 | 81591 | 86167 | 90306 | | |
| 1 | 94085 | 97561 | 00779 | 03776 | 06578 | 09211 | 11694 | 14042 | 16269 | 18388 | 20408 | 22339 | | |
| 2 | 3.24187 | 25960 | 27663 | 29302 | 30882 | 32406 | 33878 | 35302 | 36681 | 38017 | 39313 | 40572 | | |
| 3 | 41796 | 42986 | 44144 | 45272 | 46371 | 47443 | 48490 | 49512 | 50510 | 51486 | 52440 | 53374 | | |
| 4 | 54289 | 55184 | 56061 | 56921 | 57764 | 58592 | 59403 | 60200 | 60982 | 61751 | 62506 | 63249 | | |
| 5 | 3.63978 | 64696 | 65402 | 66097 | 66781 | 67454 | 68117 | 68770 | 69413 | 70047 | 70672 | 71288 | | |
| 6 | 71895 | 72494 | 73085 | 73667 | 74242 | 74810 | 75370 | 75923 | 76469 | 77009 | 77542 | 78068 | | |
| 7 | 78588 | 79102 | 79609 | 80111 | 80607 | 81098 | 81583 | 82063 | 82537 | 83007 | 83471 | 83930 | | |
| 8 | 84385 | 84835 | 85280 | 85721 | 86157 | 86589 | 87017 | 87440 | 87860 | 88275 | 88686 | 89094 | | |
| 9 | 89498 | 89898 | 90294 | 90687 | 91076 | 91462 | 91845 | 92224 | 92600 | 92972 | 93341 | 93708 | | |
| 10 | 3.94071 | 94431 | 94788 | 95143 | 95494 | 95843 | 96188 | 96532 | 96872 | 97210 | 97545 | 97877 | s | |
| 11 | 98207 | 98535 | 98860 | 99183 | 99503 | 99821 | 00136 | 00450 | 00761 | 01070 | 01376 | 01681 | 1 | 60 |
| 12 | 4.01983 | 02283 | 02581 | 02878 | 03172 | 03464 | 03754 | 04043 | 04329 | 04613 | 04896 | 05177 | 2 | 120 |
| 13 | 05456 | 05733 | 06008 | 06282 | 06554 | 06824 | 07093 | 07360 | 07625 | 07889 | 08151 | 08412 | 3 | 180 |
| 14 | 08671 | 08928 | 09184 | 09438 | 09691 | 09943 | 10193 | 10441 | 10688 | 10934 | 11178 | 11421 | 4 | 240 |
| 15 | 4.11663 | 11903 | 12142 | 12380 | 12616 | 12851 | 13085 | 13317 | 13549 | 13779 | 14007 | 14235 | s | |
| 16 | 14461 | 14687 | 14911 | 15134 | 15356 | 15576 | 15796 | 16014 | 16231 | 16448 | 16663 | 16877 | 1 | 42 |
| 17 | 17090 | 17302 | 17513 | 17723 | 17932 | 18139 | 18346 | 18552 | 18757 | 18962 | 19164 | 19366 | 2 | 84 |
| 18 | 19567 | 19768 | 19967 | 20165 | 20363 | 20559 | 20755 | 20950 | 21143 | 21336 | 21529 | 21720 | 3 | 126 |
| 19 | 21910 | 22100 | 22289 | 22477 | 22664 | 22850 | 23036 | 23221 | 23404 | 23588 | 23770 | 23952 | 4 | 168 |
| 20 | 4.24133 | 24313 | 24492 | 24671 | 24849 | 25026 | 25202 | 25378 | 25553 | 25727 | 25901 | 26074 | s | |
| 21 | 26246 | 26417 | 26588 | 26758 | 26928 | 27097 | 27265 | 27432 | 27599 | 27765 | 27931 | 28096 | 1 | 32 |
| 22 | 28260 | 28424 | 28587 | 28750 | 28911 | 29073 | 29233 | 29393 | 29553 | 29712 | 29870 | 30028 | 2 | 65 |
| 23 | 30185 | 30341 | 30497 | 30653 | 30807 | 30962 | 31115 | 31269 | 31421 | 31573 | 31725 | 31876 | 3 | 97 |
| 24 | 32026 | 32176 | 32326 | 32475 | 32623 | 32771 | 32919 | 33066 | 33212 | 33358 | 33503 | 33648 | 4 | 130 |
| 25 | 4.33793 | 33937 | 34080 | 34223 | 34365 | 34508 | 34649 | 34790 | 34931 | 35071 | 35211 | 35350 | s | |
| 26 | 35489 | 35627 | 35765 | 35903 | 36040 | 36176 | 36313 | 36448 | 36584 | 36719 | 36853 | 36987 | 1 | 26 |
| 27 | 37121 | 37254 | 37387 | 37519 | 37651 | 37783 | 37914 | 38045 | 38175 | 38305 | 38434 | 38564 | 2 | 53 |
| 28 | 38692 | 38821 | 38949 | 39077 | 39204 | 39331 | 39457 | 39583 | 39709 | 39835 | 39960 | 40084 | 3 | 79 |
| 29 | 40209 | 40333 | 40456 | 40579 | 40702 | 40825 | 40947 | 41069 | 41190 | 41311 | 41432 | 41553 | 4 | 106 |
| 30 | 4.41673 | 41793 | 41912 | 42031 | 42150 | 42268 | 42386 | 42504 | 42622 | 42739 | 42856 | 42972 | s | |
| 31 | 43088 | 43204 | 43320 | 43435 | 43550 | 43665 | 43779 | 43893 | 44007 | 44120 | 44233 | 44346 | 1 | 22 |
| 32 | 44459 | 44571 | 44683 | 44794 | 44906 | 45017 | 45127 | 45238 | 45348 | 45458 | 45568 | 45677 | 2 | 44 |
| 33 | 45786 | 45895 | 46003 | 46111 | 46219 | 46327 | 46434 | 46542 | 46648 | 46755 | 46861 | 46967 | 3 | 67 |
| 34 | 47073 | 47179 | 47284 | 47389 | 47494 | 47598 | 47702 | 47807 | 47910 | 48014 | 48117 | 48220 | 4 | 89 |
| 35 | 4.48323 | 48425 | 48527 | 48629 | 48731 | 48833 | 48934 | 49035 | 49136 | 49236 | 49336 | 49436 | s | |
| 36 | 49536 | 49636 | 49735 | 49834 | 49933 | 50032 | 50130 | 50229 | 50326 | 50424 | 50522 | 50619 | 1 | 19 |
| 37 | 50716 | 50813 | 50910 | 51006 | 51102 | 51198 | 51294 | 51389 | 51485 | 51580 | 51675 | 51769 | 2 | 38 |
| 38 | 51864 | 51958 | 52052 | 52146 | 52240 | 52333 | 52426 | 52519 | 52612 | 52705 | 52797 | 52889 | 3 | 57 |
| 39 | 52981 | 53073 | 53165 | 53256 | 53347 | 53438 | 53529 | 53620 | 53710 | 53801 | 53891 | 53980 | 4 | 77 |
| 40 | 4.54070 | 54160 | 54249 | 54338 | 54427 | 54515 | 54604 | 54692 | 54780 | 54868 | 54956 | 55044 | s | |
| 41 | 55131 | 55219 | 55306 | 55392 | 55479 | 55566 | 55652 | 55738 | 55824 | 55910 | 55996 | 56081 | 1 | 17 |
| 42 | 56166 | 56251 | 56336 | 56421 | 56506 | 56590 | 56674 | 56759 | 56842 | 56926 | 57010 | 57093 | 2 | 34 |
| 43 | 57176 | 57260 | 57343 | 57425 | 57508 | 57590 | 57673 | 57755 | 57837 | 57918 | 58000 | 58082 | 3 | 51 |
| 44 | 58163 | 58244 | 58325 | 58406 | 58487 | 58567 | 58648 | 58728 | 58808 | 58888 | 58967 | 59047 | 4 | 68 |
| 45 | 4.59127 | 59206 | 59285 | 59364 | 59443 | 59522 | 59600 | 59679 | 59757 | 59835 | 59913 | 59991 | s | |
| 46 | 60069 | 60146 | 60223 | 60301 | 60378 | 60455 | 60532 | 60608 | 60685 | 60761 | 60838 | 60914 | 1 | 15 |
| 47 | 60990 | 61066 | 61141 | 61217 | 61292 | 61368 | 61443 | 61518 | 61593 | 61667 | 61742 | 61817 | 2 | 30 |
| 48 | 61891 | 61965 | 62039 | 62113 | 62187 | 62261 | 62334 | 62408 | 62481 | 62554 | 62627 | 62700 | 3 | 45 |
| 49 | 62773 | 62846 | 62918 | 62991 | 63063 | 63135 | 63207 | 63279 | 63351 | 63422 | 63494 | 63565 | 4 | 60 |
| 50 | 4.63637 | 63708 | 63779 | 63850 | 63921 | 63991 | 64062 | 64132 | 64203 | 64273 | 64343 | 64413 | s | |
| 51 | 64483 | 64553 | 64622 | 64692 | 64761 | 64830 | 64899 | 64968 | 65037 | 65106 | 65175 | 65243 | 1 | 14 |
| 52 | 65312 | 65380 | 65448 | 65517 | 65584 | 65652 | 65720 | 65788 | 65855 | 65923 | 65990 | 66057 | 2 | 27 |
| 53 | 66125 | 66192 | 66258 | 66325 | 66392 | 66458 | 66525 | 66591 | 66658 | 66724 | 66790 | 66856 | 3 | 41 |
| 54 | 66922 | 66987 | 67053 | 67118 | 67184 | 67249 | 67314 | 67379 | 67444 | 67509 | 67574 | 67639 | 4 | 54 |
| 55 | 4.67703 | 67768 | 67832 | 67897 | 67961 | 68025 | 68089 | 68153 | 68216 | 68280 | 68344 | 68407 | s | |
| 56 | 68471 | 68534 | 68597 | 68660 | 68723 | 68786 | 68849 | 68912 | 68974 | 69037 | 69099 | 69161 | 1 | 12 |
| 57 | 69224 | 69286 | 69348 | 69410 | 69472 | 69533 | 69595 | 69657 | 69718 | 69779 | 69841 | 69902 | 2 | 25 |
| 58 | 69963 | 70024 | 70085 | 70146 | 70206 | 70267 | 70328 | 70388 | 70449 | 70509 | 70569 | 70629 | 3 | 37 |
| 59 | 70689 | 70749 | 70809 | 70869 | 70928 | 70988 | 71047 | 71107 | 71166 | 71225 | 71285 | 71344 | 4 | 50 |

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

1 Hour.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.71403 | 71462 | 71520 | 71579 | 71638 | 71696 | 71755 | 71813 | 71871 | 71930 | 71988 | 72046 | s |
| 1 | 72104 | 72162 | 72219 | 72277 | 72335 | 72392 | 72450 | 72507 | 72564 | 72622 | 72679 | 72736 | 1 \| 11 |
| 2 | 72793 | 72850 | 72907 | 72963 | 73020 | 73077 | 73133 | 73190 | 73246 | 73302 | 73358 | 73414 | 2 \| 22 |
| 3 | 73470 | 73526 | 73582 | 73638 | 73694 | 73749 | 73805 | 73861 | 73916 | 73971 | 74027 | 74082 | 3 \| 34 |
| 4 | 74137 | 74192 | 74247 | 74302 | 74356 | 74411 | 74466 | 74521 | 74575 | 74629 | 74684 | 74738 | 4 \| 45 |
| 5 | 1.74792 | 74846 | 74900 | 74955 | 75008 | 75062 | 75116 | 75170 | 75223 | 75277 | 75330 | 75384 | s |
| 6 | 75437 | 75491 | 75544 | 75597 | 75650 | 75703 | 75756 | 75809 | 75861 | 75914 | 75967 | 76019 | 1 \| 10 |
| 7 | 76072 | 76124 | 76177 | 76229 | 76281 | 76333 | 76385 | 76437 | 76489 | 76541 | 76593 | 76645 | 2 \| 21 |
| 8 | 76697 | 76748 | 76800 | 76851 | 76903 | 76954 | 77005 | 77057 | 77108 | 77159 | 77210 | 77261 | 3 \| 31 |
| 9 | 77312 | 77362 | 77413 | 77464 | 77514 | 77565 | 77616 | 77666 | 77716 | 77767 | 77817 | 77867 | 4 \| 42 |
| 10 | 1.77917 | 77967 | 78017 | 78067 | 78117 | 78167 | 78217 | 78266 | 78316 | 78365 | 78415 | 78464 | s |
| 11 | 78514 | 78563 | 78612 | 78661 | 78710 | 78760 | 78809 | 78858 | 78906 | 78955 | 79004 | 79053 | 1 \| 10 |
| 12 | 79101 | 79150 | 79198 | 79247 | 79295 | 79344 | 79392 | 79440 | 79488 | 79536 | 79584 | 79632 | 2 \| 19 |
| 13 | 79680 | 79728 | 79776 | 79824 | 79871 | 79919 | 79966 | 80014 | 80061 | 80109 | 80156 | 80203 | 3 \| 29 |
| 14 | 80251 | 80298 | 80345 | 80392 | 80439 | 80486 | 80533 | 80580 | 80626 | 80673 | 80720 | 80766 | 4 \| 38 |
| 15 | 1.80813 | 80859 | 80906 | 80952 | 80999 | 81045 | 81091 | 81137 | 81183 | 81229 | 81275 | 81321 | s |
| 16 | 81367 | 81413 | 81459 | 81505 | 81550 | 81596 | 81641 | 81687 | 81732 | 81778 | 81823 | 81868 | 1 \| 9 |
| 17 | 81914 | 81959 | 82004 | 82049 | 82094 | 82139 | 82184 | 82229 | 82274 | 82319 | 82363 | 82408 | 2 \| 18 |
| 18 | 82453 | 82497 | 82542 | 82586 | 82630 | 82675 | 82719 | 82763 | 82808 | 82852 | 82896 | 82940 | 3 \| 27 |
| 19 | 82984 | 83028 | 83072 | 83116 | 83159 | 83203 | 83247 | 83291 | 83334 | 83378 | 83421 | 83465 | 4 \| 36 |
| 20 | 1.83508 | 83552 | 83595 | 83638 | 83681 | 83725 | 83768 | 83811 | 83854 | 83897 | 83940 | 83983 | s |
| 21 | 84025 | 84068 | 84111 | 84154 | 84196 | 84239 | 84281 | 84324 | 84366 | 84409 | 84451 | 84493 | 1 \| 8 |
| 22 | 84536 | 84578 | 84620 | 84662 | 84704 | 84746 | 84788 | 84830 | 84872 | 84914 | 84956 | 84997 | 2 \| 17 |
| 23 | 85039 | 85081 | 85122 | 85164 | 85205 | 85247 | 85288 | 85330 | 85371 | 85412 | 85454 | 85495 | 3 \| 25 |
| 24 | 85536 | 85577 | 85618 | 85659 | 85700 | 85741 | 85782 | 85823 | 85864 | 85904 | 85945 | 85986 | 4 \| 34 |
| 25 | 1.86026 | 86067 | 86108 | 86148 | 86188 | 86229 | 86269 | 86310 | 86350 | 86390 | 86430 | 86470 | s |
| 26 | 86511 | 86551 | 86591 | 86631 | 86671 | 86710 | 86750 | 86790 | 86830 | 86870 | 86909 | 86949 | 1 \| 8 |
| 27 | 86989 | 87028 | 87068 | 87107 | 87147 | 87186 | 87225 | 87265 | 87304 | 87343 | 87382 | 87421 | 2 \| 16 |
| 28 | 87461 | 87500 | 87539 | 87578 | 87617 | 87656 | 87694 | 87733 | 87772 | 87811 | 87849 | 87888 | 3 \| 24 |
| 29 | 87927 | 87965 | 88004 | 88042 | 88081 | 88119 | 88158 | 88196 | 88234 | 88272 | 88311 | 88349 | 4 \| 32 |
| 30 | 1.88387 | 88425 | 88463 | 88501 | 88539 | 88577 | 88615 | 88653 | 88691 | 88729 | 88766 | 88804 | s |
| 31 | 88842 | 88879 | 88917 | 88954 | 88992 | 89030 | 89067 | 89104 | 89142 | 89179 | 89216 | 89254 | 1 \| 7 |
| 32 | 89291 | 89328 | 89365 | 89402 | 89439 | 89476 | 89513 | 89550 | 89587 | 89624 | 89661 | 89698 | 2 \| 15 |
| 33 | 89735 | 89771 | 89808 | 89845 | 89881 | 89918 | 89954 | 89991 | 90027 | 90064 | 90100 | 90137 | 3 \| 22 |
| 34 | 90173 | 90209 | 90246 | 90282 | 90318 | 90354 | 90390 | 90426 | 90462 | 90498 | 90534 | 90570 | 4 \| 30 |
| 35 | 1.90606 | 90642 | 90678 | 90714 | 90749 | 90785 | 90821 | 90857 | 90892 | 90928 | 90963 | 90999 | s |
| 36 | 91034 | 91070 | 91105 | 91141 | 91176 | 91211 | 91247 | 91282 | 91317 | 91352 | 91387 | 91422 | 1 \| 7 |
| 37 | 91457 | 91493 | 91527 | 91563 | 91597 | 91632 | 91667 | 91702 | 91737 | 91772 | 91806 | 91841 | 2 \| 14 |
| 38 | 91876 | 91910 | 91945 | 91980 | 92014 | 92049 | 92083 | 92117 | 92152 | 92186 | 92221 | 92255 | 3 \| 21 |
| 39 | 92289 | 92323 | 92358 | 92392 | 92426 | 92460 | 92494 | 92528 | 92562 | 92596 | 92630 | 92664 | 4 \| 28 |
| 40 | 1.92698 | 92732 | 92765 | 92799 | 92833 | 92867 | 92900 | 92934 | 92968 | 93001 | 93035 | 93068 | s |
| 41 | 93102 | 93135 | 93169 | 93202 | 93236 | 93269 | 93302 | 93336 | 93369 | 93402 | 93435 | 93468 | 1 \| 7 |
| 42 | 93501 | 93535 | 93568 | 93601 | 93634 | 93667 | 93700 | 93732 | 93765 | 93798 | 93831 | 93864 | 2 \| 13 |
| 43 | 93897 | 93929 | 93962 | 93995 | 94027 | 94060 | 94092 | 94125 | 94157 | 94190 | 94222 | 94255 | 3 \| 20 |
| 44 | 94287 | 94320 | 94352 | 94384 | 94416 | 94449 | 94481 | 94513 | 94545 | 94577 | 94609 | 94642 | 4 \| 26 |
| 45 | 1.94674 | 94706 | 94738 | 94770 | 94801 | 94833 | 94865 | 94897 | 94929 | 94961 | 94992 | 95024 | s |
| 46 | 95056 | 95087 | 95119 | 95151 | 95182 | 95214 | 95245 | 95277 | 95308 | 95340 | 95371 | 95402 | 1 \| 6 |
| 47 | 95434 | 95465 | 95496 | 95528 | 95559 | 95590 | 95621 | 95652 | 95683 | 95715 | 95746 | 95777 | 2 \| 12 |
| 48 | 95808 | 95839 | 95870 | 95901 | 95931 | 95962 | 95993 | 96024 | 96055 | 96086 | 96116 | 96147 | 3 \| 19 |
| 49 | 96178 | 96208 | 96239 | 96269 | 96300 | 96331 | 96361 | 96392 | 96422 | 96452 | 96483 | 96513 | 4 \| 25 |
| 50 | 1.96544 | 96574 | 96604 | 96634 | 96665 | 96695 | 96725 | 96755 | 96785 | 96816 | 96846 | 96876 | s |
| 51 | 96906 | 96936 | 96966 | 96996 | 97025 | 97055 | 97085 | 97115 | 97145 | 97175 | 97204 | 97234 | 1 \| 6 |
| 52 | 97264 | 97294 | 97323 | 97353 | 97383 | 97412 | 97442 | 97471 | 97501 | 97530 | 97560 | 97589 | 2 \| 12 |
| 53 | 97618 | 97648 | 97677 | 97707 | 97736 | 97765 | 97794 | 97824 | 97853 | 97882 | 97911 | 97940 | 3 \| 18 |
| 54 | 97969 | 97998 | 98027 | 98056 | 98085 | 98114 | 98143 | 98172 | 98201 | 98230 | 98259 | 98288 | 4 \| 24 |
| 55 | 1.98316 | 98345 | 98374 | 98403 | 98431 | 98460 | 98489 | 98517 | 98546 | 98575 | 98603 | 98632 | s |
| 56 | 98660 | 98689 | 98717 | 98746 | 98774 | 98802 | 98831 | 98859 | 98887 | 98916 | 98944 | 98972 | 1 \| 6 |
| 57 | 99000 | 99028 | 99057 | 99085 | 99113 | 99141 | 99169 | 99197 | 99225 | 99253 | 99281 | 99309 | 2 \| 12 |
| 58 | 99337 | 99365 | 99393 | 99421 | 99448 | 99476 | 99504 | 99532 | 99559 | 99587 | 99615 | 99643 | 3 \| 17 |

# TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## MIDDLE TIME.

### 2 Hours.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.00000 | 00027 | 00055 | 00082 | 00109 | 00137 | 00164 | 00191 | 00218 | 00245 | 00272 | 00300 | s |
| 1 | 00327 | 00354 | 00381 | 00408 | 00435 | 00462 | 00489 | 00516 | 00542 | 00569 | 00596 | 00623 | 1 \| 5 |
| 2 | 00650 | 00677 | 00703 | 00730 | 00757 | 00784 | 00810 | 00837 | 00864 | 00890 | 00917 | 00943 | 2 \| 10 |
| 3 | 00970 | 00997 | 01023 | 01050 | 01076 | 01103 | 01129 | 01155 | 01182 | 01208 | 01234 | 01261 | 3 \| 16 |
| 4 | 01287 | 01313 | 01339 | 01366 | 01392 | 01418 | 01444 | 01470 | 01496 | 01523 | 01549 | 01575 | 4 \| 21 |
| 5 | 5.01601 | 01627 | 01653 | 01679 | 01705 | 01731 | 01757 | 01782 | 01808 | 01834 | 01860 | 01886 | s |
| 6 | 01912 | 01937 | 01963 | 01989 | 02014 | 02040 | 02066 | 02091 | 02117 | 02143 | 02168 | 02194 | 1 \| 5 |
| 7 | 02219 | 02245 | 02270 | 02296 | 02321 | 02347 | 02372 | 02397 | 02423 | 02448 | 02473 | 02499 | 2 \| 10 |
| 8 | 02524 | 02549 | 02574 | 02600 | 02625 | 02650 | 02675 | 02700 | 02725 | 02751 | 02776 | 02801 | 3 \| 15 |
| 9 | 02826 | 02851 | 02876 | 02901 | 02926 | 02951 | 02976 | 03001 | 03025 | 03050 | 03075 | 03100 | 4 \| 20 |
| 10 | 5.03125 | 03149 | 03174 | 03199 | 03224 | 03248 | 03273 | 03298 | 03322 | 03347 | 03372 | 03396 | s |
| 11 | 03421 | 03445 | 03470 | 03494 | 03519 | 03543 | 03568 | 03592 | 03616 | 03641 | 03665 | 03690 | 1 \| 5 |
| 12 | 03714 | 03738 | 03762 | 03787 | 03811 | 03835 | 03859 | 03884 | 03908 | 03932 | 03956 | 03980 | 2 \| 10 |
| 13 | 04004 | 04028 | 04052 | 04077 | 04100 | 04125 | 04148 | 04172 | 04196 | 04220 | 04244 | 04268 | 3 \| 14 |
| 14 | 04292 | 04316 | 04340 | 04363 | 04387 | 04411 | 04435 | 04459 | 04482 | 04506 | 04530 | 04553 | 4 \| 19 |
| 15 | 5.04577 | 04601 | 04624 | 04648 | 04671 | 04695 | 04718 | 04742 | 04765 | 04789 | 04812 | 04836 | s |
| 16 | 04859 | 04883 | 04906 | 04929 | 04953 | 04976 | 04999 | 05023 | 05046 | 05069 | 05092 | 05116 | 1 \| 5 |
| 17 | 05139 | 05162 | 05185 | 05208 | 05231 | 05255 | 05278 | 05301 | 05324 | 05347 | 05370 | 05393 | 2 \| 9 |
| 18 | 05416 | 05439 | 05462 | 05485 | 05508 | 05531 | 05553 | 05576 | 05599 | 05622 | 05645 | 05668 | 3 \| 14 |
| 19 | 05690 | 05713 | 05736 | 05758 | 05781 | 05804 | 05827 | 05849 | 05872 | 05894 | 05917 | 05940 | 4 \| 18 |
| 20 | 5.05962 | 05985 | 06007 | 06030 | 06052 | 06075 | 06097 | 06120 | 06142 | 06164 | 06187 | 06209 | s |
| 21 | 06232 | 06254 | 06276 | 06299 | 06321 | 06343 | 06365 | 06388 | 06410 | 06432 | 06454 | 06476 | 1 \| 4 |
| 22 | 06498 | 06521 | 06543 | 06565 | 06587 | 06609 | 06631 | 06653 | 06675 | 06697 | 06719 | 06741 | 2 \| 9 |
| 23 | 06763 | 06785 | 06807 | 06829 | 06850 | 06872 | 06894 | 06916 | 06938 | 06960 | 06981 | 07003 | 3 \| 13 |
| 24 | 07025 | 07047 | 07068 | 07090 | 07112 | 07133 | 07155 | 07176 | 07198 | 07220 | 07241 | 07263 | 4 \| 18 |
| 25 | 5.07284 | 07306 | 07328 | 07349 | 07371 | 07392 | 07413 | 07435 | 07456 | 07478 | 07499 | 07520 | s |
| 26 | 07542 | 07563 | 07584 | 07606 | 07627 | 07648 | 07670 | 07691 | 07712 | 07733 | 07754 | 07776 | 1 \| 4 |
| 27 | 07797 | 07818 | 07839 | 07860 | 07881 | 07902 | 07923 | 07944 | 07965 | 07986 | 08007 | 08028 | 2 \| 8 |
| 28 | 08049 | 08070 | 08091 | 08112 | 08133 | 08154 | 08175 | 08196 | 08216 | 08237 | 08258 | 08279 | 3 \| 13 |
| 29 | 08300 | 08320 | 08341 | 08362 | 08383 | 08403 | 08424 | 08445 | 08465 | 08486 | 08507 | 08527 | 4 \| 17 |
| 30 | 5.08548 | 08568 | 08589 | 08609 | 08630 | 08650 | 08671 | 08691 | 08712 | 08732 | 08753 | 08773 | s |
| 31 | 08794 | 08814 | 08834 | 08855 | 08875 | 08895 | 08916 | 08936 | 08956 | 08977 | 08997 | 09017 | 1 \| 4 |
| 32 | 09037 | 09057 | 09078 | 09098 | 09118 | 09138 | 09158 | 09178 | 09198 | 09219 | 09239 | 09259 | 2 \| 8 |
| 33 | 09279 | 09299 | 09319 | 09339 | 09359 | 09379 | 09399 | 09419 | 09438 | 09458 | 09478 | 09498 | 3 \| 12 |
| 34 | 09518 | 09538 | 09558 | 09577 | 09597 | 09617 | 09637 | 09657 | 09676 | 09696 | 09716 | 09735 | 4 \| 16 |
| 35 | 5.09755 | 09775 | 09794 | 09814 | 09834 | 09853 | 09873 | 09893 | 09912 | 09932 | 09951 | 09971 | s |
| 36 | 09990 | 10010 | 10029 | 10049 | 10068 | 10088 | 10107 | 10126 | 10146 | 10165 | 10184 | 10204 | 1 \| 4 |
| 37 | 10223 | 10243 | 10262 | 10281 | 10300 | 10320 | 10339 | 10358 | 10377 | 10397 | 10416 | 10435 | 2 \| 8 |
| 38 | 10454 | 10473 | 10492 | 10512 | 10531 | 10550 | 10569 | 10588 | 10607 | 10626 | 10645 | 10664 | 3 \| 11 |
| 39 | 10683 | 10702 | 10721 | 10740 | 10759 | 10778 | 10797 | 10816 | 10834 | 10853 | 10872 | 10891 | 4 \| 15 |
| 40 | 5.10910 | 10929 | 10947 | 10966 | 10985 | 11004 | 11022 | 11041 | 11060 | 11079 | 11097 | 11116 | s |
| 41 | 11135 | 11153 | 11172 | 11190 | 11209 | 11228 | 11246 | 11265 | 11283 | 11302 | 11320 | 11339 | 1 \| 4 |
| 42 | 11357 | 11376 | 11394 | 11413 | 11431 | 11450 | 11468 | 11487 | 11505 | 11523 | 11542 | 11560 | 2 \| 7 |
| 43 | 11578 | 11597 | 11615 | 11633 | 11652 | 11670 | 11688 | 11706 | 11725 | 11743 | 11761 | 11779 | 3 \| 11 |
| 44 | 11797 | 11815 | 11834 | 11852 | 11870 | 11888 | 11906 | 11924 | 11942 | 11960 | 11978 | 11996 | 4 \| 14 |
| 45 | 5.12014 | 12032 | 12050 | 12068 | 12086 | 12104 | 12122 | 12140 | 12158 | 12176 | 12194 | 12212 | s |
| 46 | 12229 | 12247 | 12265 | 12283 | 12301 | 12319 | 12336 | 12354 | 12372 | 12390 | 12407 | 12425 | 1 \| 4 |
| 47 | 12443 | 12460 | 12478 | 12496 | 12513 | 12531 | 12549 | 12566 | 12584 | 12601 | 12619 | 12637 | 2 \| 7 |
| 48 | 12654 | 12672 | 12689 | 12707 | 12724 | 12742 | 12759 | 12777 | 12794 | 12811 | 12829 | 12846 | 3 \| 11 |
| 49 | 12864 | 12881 | 12898 | 12916 | 12933 | 12950 | 12968 | 12985 | 13002 | 13020 | 13037 | 13054 | 4 \| 14 |
| 50 | 5.13071 | 13089 | 13106 | 13123 | 13140 | 13157 | 13175 | 13192 | 13209 | 13226 | 13243 | 13260 | s |
| 51 | 13277 | 13294 | 13311 | 13328 | 13345 | 13363 | 13380 | 13397 | 13413 | 13431 | 13447 | 13464 | 1 \| 3 |
| 52 | 13481 | 13498 | 13515 | 13532 | 13549 | 13566 | 13583 | 13600 | 13616 | 13633 | 13650 | 13667 | 2 \| 7 |
| 53 | 13684 | 13700 | 13717 | 13734 | 13751 | 13767 | 13784 | 13801 | 13818 | 13834 | 13851 | 13868 | 3 \| 10 |
| 54 | 13884 | 13901 | 13917 | 13934 | 13951 | 13967 | 13984 | 14000 | 14017 | 14034 | 14050 | 14067 | 4 \| 14 |
| 55 | 5.14083 | 14100 | 14116 | 14133 | 14149 | 14165 | 14182 | 14198 | 14215 | 14231 | 14247 | 14264 | s |
| 56 | 14280 | 14297 | 14313 | 14329 | 14345 | 14362 | 14378 | 14394 | 14411 | 14427 | 14443 | 14459 | 1 \| 3 |
| 57 | 14476 | 14492 | 14508 | 14524 | 14540 | 14556 | 14573 | 14589 | 14605 | 14621 | 14637 | 14653 | 2 \| 6 |
| 58 | 14669 | 14685 | 14701 | 14717 | 14733 | 14749 | 14765 | 14781 | 14797 | 14813 | 14829 | 14845 | 3 \| 10 |
| 59 | 14861 | 14877 | 14893 | 14909 | 14925 | 14941 | 14957 | 14972 | 14988 | 15004 | 15020 | 15036 | 4 \| 13 |

# TABLE XXVIII.

## To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

### MIDDLE TIME.

### 3 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.15051 | 15067 | 15083 | 15099 | 15115 | 15130 | 15146 | 15162 | 15177 | 15193 | 15209 | 15225 | s |
| 1 | 15240 | 15256 | 15271 | 15287 | 15303 | 15318 | 15334 | 15350 | 15365 | 15381 | 15396 | 15412 | 1 \| 3 |
| 2 | 15427 | 15443 | 15458 | 15474 | 15489 | 15505 | 15520 | 15536 | 15551 | 15566 | 15582 | 15597 | 2 \| 6 |
| 3 | 15613 | 15628 | 15643 | 15659 | 15674 | 15689 | 15705 | 15720 | 15735 | 15751 | 15766 | 15781 | 3 \| 10 |
| 4 | 15796 | 15812 | 15827 | 15842 | 15857 | 15873 | 15888 | 15903 | 15918 | 15933 | 15948 | 15964 | 4 \| 13 |
| 5 | 5.15979 | 15994 | 16009 | 16024 | 16039 | 16054 | 16069 | 16084 | 16099 | 16114 | 16129 | 16144 | s |
| 6 | 16159 | 16174 | 16189 | 16204 | 16219 | 16234 | 16249 | 16264 | 16279 | 16294 | 16309 | 16323 | 1 \| 3 |
| 7 | 16338 | 16353 | 16368 | 16383 | 16398 | 16412 | 16427 | 16442 | 16457 | 16472 | 16486 | 16501 | 2 \| 6 |
| 8 | 16516 | 16531 | 16545 | 16560 | 16575 | 16589 | 16604 | 16619 | 16633 | 16648 | 16662 | 16677 | 3 \| 9 |
| 9 | 16692 | 16706 | 16721 | 16735 | 16750 | 16765 | 16779 | 16794 | 16808 | 16823 | 16837 | 16852 | 4 \| 12 |
| 10 | 5.16866 | 16881 | 16895 | 16909 | 16924 | 16938 | 16953 | 16967 | 16982 | 16996 | 17010 | 17025 | s |
| 11 | 17039 | 17053 | 17068 | 17082 | 17096 | 17111 | 17125 | 17139 | 17153 | 17168 | 17182 | 17196 | 1 \| 3 |
| 12 | 17210 | 17225 | 17239 | 17253 | 17267 | 17281 | 17295 | 17310 | 17324 | 17338 | 17352 | 17366 | 2 \| 6 |
| 13 | 17380 | 17394 | 17408 | 17423 | 17437 | 17451 | 17465 | 17479 | 17493 | 17507 | 17521 | 17535 | 3 \| 8 |
| 14 | 17549 | 17563 | 17577 | 17591 | 17604 | 17618 | 17632 | 17646 | 17660 | 17674 | 17688 | 17702 | 4 \| 11 |
| 15 | 5.17716 | 17729 | 17743 | 17757 | 17771 | 17785 | 17798 | 17812 | 17826 | 17840 | 17854 | 17867 | s |
| 16 | 17881 | 17895 | 17908 | 17922 | 17936 | 17950 | 17963 | 17977 | 17990 | 18004 | 18018 | 18031 | 1 \| 3 |
| 17 | 18045 | 18059 | 18072 | 18086 | 18099 | 18113 | 18126 | 18140 | 18154 | 18167 | 18181 | 18194 | 2 \| 5 |
| 18 | 18208 | 18221 | 18235 | 18248 | 18261 | 18275 | 18288 | 18302 | 18315 | 18329 | 18342 | 18355 | 3 \| 8 |
| 19 | 18369 | 18382 | 18395 | 18409 | 18422 | 18435 | 18449 | 18462 | 18475 | 18489 | 18502 | 18515 | 4 \| 10 |
| 20 | 5.18528 | 18542 | 18555 | 18568 | 18581 | 18595 | 18608 | 18621 | 18634 | 18647 | 18660 | 18674 | s |
| 21 | 18687 | 18700 | 18713 | 18726 | 18739 | 18752 | 18765 | 18778 | 18791 | 18805 | 18818 | 18831 | 1 \| 3 |
| 22 | 18844 | 18857 | 18870 | 18883 | 18896 | 18909 | 18922 | 18935 | 18947 | 18960 | 18973 | 18986 | 2 \| 5 |
| 23 | 18999 | 19012 | 19025 | 19038 | 19051 | 19064 | 19076 | 19089 | 19102 | 19115 | 19128 | 19141 | 3 \| 8 |
| 24 | 19153 | 19166 | 19179 | 19192 | 19204 | 19217 | 19230 | 19243 | 19255 | 19268 | 19281 | 19293 | 4 \| 10 |
| 25 | 5.19306 | 19319 | 19331 | 19344 | 19357 | 19369 | 19382 | 19395 | 19407 | 19420 | 19432 | 19445 | s |
| 26 | 19457 | 19470 | 19483 | 19495 | 19508 | 19520 | 19533 | 19545 | 19558 | 19570 | 19583 | 19595 | 1 \| 2 |
| 27 | 19607 | 19620 | 19632 | 19645 | 19657 | 19670 | 19682 | 19694 | 19707 | 19719 | 19732 | 19744 | 2 \| 5 |
| 28 | 19756 | 19769 | 19781 | 19793 | 19805 | 19818 | 19830 | 19842 | 19855 | 19867 | 19879 | 19891 | 3 \| 7 |
| 29 | 19904 | 19916 | 19928 | 19940 | 19952 | 19965 | 19977 | 19989 | 20001 | 20013 | 20025 | 20038 | 4 \| 10 |
| 30 | 5.20050 | 20062 | 20074 | 20086 | 20098 | 20110 | 20122 | 20134 | 20146 | 20158 | 20170 | 20182 | s |
| 31 | 20194 | 20206 | 20218 | 20230 | 20242 | 20254 | 20266 | 20278 | 20290 | 20302 | 20314 | 20326 | 1 \| 2 |
| 32 | 20338 | 20350 | 20362 | 20374 | 20385 | 20397 | 20409 | 20421 | 20433 | 20445 | 20456 | 20468 | 2 \| 5 |
| 33 | 20480 | 20492 | 20504 | 20515 | 20527 | 20539 | 20551 | 20562 | 20574 | 20586 | 20597 | 20609 | 3 \| 7 |
| 34 | 20621 | 20633 | 20644 | 20656 | 20668 | 20679 | 20691 | 20702 | 20714 | 20726 | 20737 | 20749 | 4 \| 10 |
| 35 | 5.20760 | 20772 | 20784 | 20795 | 20807 | 20818 | 20830 | 20841 | 20853 | 20864 | 20876 | 20887 | s |
| 36 | 20899 | 20910 | 20922 | 20933 | 20945 | 20956 | 20967 | 20979 | 20990 | 21002 | 21013 | 21024 | 1 \| 2 |
| 37 | 21036 | 21047 | 21059 | 21070 | 21081 | 21093 | 21104 | 21115 | 21126 | 21138 | 21149 | 21160 | 2 \| 4 |
| 38 | 21172 | 21183 | 21194 | 21205 | 21217 | 21228 | 21239 | 21250 | 21261 | 21273 | 21284 | 21295 | 3 \| 7 |
| 39 | 21306 | 21317 | 21328 | 21340 | 21351 | 21362 | 21373 | 21384 | 21395 | 21406 | 21417 | 21428 | 4 \| 9 |
| 40 | 5.21439 | 21451 | 21462 | 21473 | 21484 | 21495 | 21506 | 21517 | 21528 | 21539 | 21550 | 21561 | s |
| 41 | 21572 | 21583 | 21593 | 21604 | 21615 | 21626 | 21637 | 21648 | 21659 | 21670 | 21681 | 21692 | 1 \| 2 |
| 42 | 21702 | 21713 | 21724 | 21735 | 21746 | 21757 | 21767 | 21778 | 21789 | 21800 | 21810 | 21821 | 2 \| 4 |
| 43 | 21832 | 21843 | 21853 | 21864 | 21875 | 21886 | 21896 | 21907 | 21918 | 21928 | 21939 | 21950 | 3 \| 7 |
| 44 | 21960 | 21971 | 21982 | 21992 | 22003 | 22014 | 22024 | 22034 | 22045 | 22056 | 22067 | 22077 | 4 \| 9 |
| 45 | 5.22088 | 22098 | 22109 | 22119 | 22130 | 22140 | 22151 | 22161 | 22172 | 22182 | 22193 | 22203 | s |
| 46 | 22214 | 22224 | 22235 | 22245 | 22255 | 22266 | 22276 | 22287 | 22297 | 22307 | 22318 | 22328 | 1 \| 2 |
| 47 | 22338 | 22349 | 22359 | 22370 | 22380 | 22390 | 22400 | 22411 | 22421 | 22431 | 22442 | 22452 | 2 \| 4 |
| 48 | 22462 | 22472 | 22483 | 22493 | 22503 | 22513 | 22524 | 22534 | 22544 | 22554 | 22564 | 22574 | 3 \| 6 |
| 49 | 22585 | 22595 | 22605 | 22615 | 22625 | 22635 | 22645 | 22656 | 22666 | 22676 | 22686 | 22696 | 4 \| 8 |
| 50 | 5.22706 | 22716 | 22726 | 22736 | 22746 | 22756 | 22766 | 22776 | 22786 | 22796 | 22806 | 22816 | s |
| 51 | 22826 | 22836 | 22846 | 22856 | 22866 | 22876 | 22886 | 22896 | 22906 | 22915 | 22925 | 22935 | 1 \| 2 |
| 52 | 22945 | 22955 | 22965 | 22975 | 22984 | 22994 | 23004 | 23014 | 23024 | 23034 | 23043 | 23053 | 2 \| 4 |
| 53 | 23063 | 23073 | 23082 | 23092 | 23102 | 23112 | 23121 | 23131 | 23141 | 23151 | 23160 | 23170 | 3 \| 6 |
| 54 | 23180 | 23189 | 23199 | 23209 | 23218 | 23228 | 23237 | 23247 | 23257 | 23266 | 23276 | 23286 | 4 \| 8 |
| 55 | 5.23295 | 23305 | 23314 | 23324 | 23333 | 23343 | 23352 | 23362 | 23372 | 23381 | 23391 | 23400 | s |
| 56 | 23410 | 23419 | 23429 | 23438 | 23447 | 23457 | 23466 | 23476 | 23485 | 23495 | 23504 | 23514 | 1 \| 2 |
| 57 | 23523 | 23532 | 23542 | 23551 | 23560 | 23570 | 23579 | 23588 | 23598 | 23607 | 23616 | 23626 | 2 \| 4 |
| 58 | 23635 | 23644 | 23654 | 23663 | 23672 | 23681 | 23691 | 23700 | 23709 | 23718 | 23728 | 23737 | 3 \| 6 |

# TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## MIDDLE TIME.

### 4 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.23856 | 23865 | 23874 | 23883 | 23892 | 23902 | 23911 | 23920 | 23929 | 23938 | 23947 | 23956 | s |
| 1 | 23965 | 23974 | 23983 | 23992 | 24001 | 24010 | 24019 | 24028 | 24037 | 24046 | 24055 | 24064 | 1 \| 2 |
| 2 | 24073 | 24082 | 24091 | 24099 | 24108 | 24117 | 24126 | 24135 | 24144 | 24153 | 24162 | 24171 | 2 \| 4 |
| 3 | 24179 | 24188 | 24197 | 24206 | 24215 | 24224 | 24232 | 24241 | 24250 | 24259 | 24267 | 24276 | 3 \| 5 |
| 4 | 24285 | 24294 | 24302 | 24311 | 24320 | 24329 | 24337 | 24346 | 24355 | 24363 | 24372 | 24381 | 4 \| 7 |
| 5 | 5.24389 | 24398 | 24407 | 24415 | 24424 | 24433 | 24441 | 24450 | 24458 | 24467 | 24476 | 24484 | s |
| 6 | 24493 | 24501 | 24510 | 24519 | 24527 | 24536 | 24544 | 24553 | 24561 | 24570 | 24578 | 24587 | 1 \| 2 |
| 7 | 24595 | 24604 | 24612 | 24621 | 24629 | 24638 | 24646 | 24654 | 24663 | 24671 | 24680 | 24688 | 2 \| 4 |
| 8 | 24696 | 24705 | 24713 | 24722 | 24730 | 24738 | 24747 | 24755 | 24763 | 24772 | 24780 | 24788 | 3 \| 5 |
| 9 | 24797 | 24805 | 24813 | 24822 | 24830 | 24838 | 24846 | 24855 | 24863 | 24871 | 24879 | 24888 | 4 \| 7 |
| 10 | 5.24896 | 24904 | 24912 | 24921 | 24929 | 24937 | 24945 | 24953 | 24961 | 24970 | 24978 | 24986 | s |
| 11 | 24994 | 25002 | 25010 | 25018 | 25026 | 25035 | 25043 | 25051 | 25059 | 25067 | 25075 | 25083 | 1 \| 2 |
| 12 | 25091 | 25099 | 25107 | 25115 | 25123 | 25131 | 25139 | 25147 | 25155 | 25163 | 25171 | 25179 | 2 \| 3 |
| 13 | 25187 | 25195 | 25203 | 25211 | 25219 | 25227 | 25235 | 25243 | 25251 | 25259 | 25266 | 25274 | 3 \| 5 |
| 14 | 25282 | 25290 | 25298 | 25306 | 25314 | 25321 | 25329 | 25337 | 25345 | 25353 | 25360 | 25368 | 4 \| 6 |
| 15 | 5.25376 | 25384 | 25392 | 25399 | 25407 | 25415 | 25423 | 25430 | 25438 | 25446 | 25454 | 25461 | s |
| 16 | 25469 | 25477 | 25484 | 25492 | 25500 | 25507 | 25515 | 25523 | 25530 | 25538 | 25546 | 25553 | 1 \| 2 |
| 17 | 25561 | 25569 | 25576 | 25584 | 25591 | 25599 | 25607 | 25614 | 25622 | 25629 | 25637 | 25644 | 2 \| 3 |
| 18 | 25652 | 25659 | 25667 | 25674 | 25682 | 25689 | 25697 | 25704 | 25712 | 25719 | 25727 | 25734 | 3 \| 5 |
| 19 | 25742 | 25749 | 25757 | 25764 | 25771 | 25779 | 25786 | 25794 | 25801 | 25808 | 25816 | 25823 | 4 \| 6 |
| 20 | 5.25831 | 25838 | 25845 | 25853 | 25860 | 25867 | 25875 | 25882 | 25889 | 25897 | 25904 | 25911 | s |
| 21 | 25918 | 25926 | 25933 | 25940 | 25947 | 25955 | 25962 | 25969 | 25976 | 25984 | 25991 | 25998 | 1 \| 1 |
| 22 | 26005 | 26013 | 26020 | 26027 | 26034 | 26041 | 26048 | 26056 | 26063 | 26070 | 26077 | 26084 | 2 \| 3 |
| 23 | 26091 | 26098 | 26105 | 26113 | 26120 | 26127 | 26134 | 26141 | 26148 | 26155 | 26162 | 26169 | 3 \| 4 |
| 24 | 26176 | 26183 | 26190 | 26197 | 26204 | 26211 | 26218 | 26225 | 26232 | 26239 | 26246 | 26253 | 4 \| 6 |
| 25 | 5.26260 | 26267 | 26274 | 26281 | 26288 | 26295 | 26301 | 26308 | 26315 | 26322 | 26329 | 26336 | s |
| 26 | 26343 | 26350 | 26356 | 26363 | 26370 | 26377 | 26384 | 26391 | 26397 | 26404 | 26411 | 26418 | 1 \| 1 |
| 27 | 26425 | 26432 | 26438 | 26445 | 26452 | 26459 | 26465 | 26472 | 26479 | 26486 | 26492 | 26499 | 2 \| 3 |
| 28 | 26506 | 26512 | 26519 | 26526 | 26532 | 26539 | 26546 | 26552 | 26559 | 26566 | 26572 | 26579 | 3 \| 4 |
| 29 | 26586 | 26592 | 26599 | 26605 | 26612 | 26619 | 26625 | 26632 | 26638 | 26645 | 26651 | 26658 | 4 \| 6 |
| 30 | 5.26665 | 26671 | 26678 | 26684 | 26691 | 26697 | 26704 | 26710 | 26717 | 26723 | 26730 | 26736 | s |
| 31 | 26743 | 26749 | 26755 | 26762 | 26768 | 26775 | 26781 | 26788 | 26794 | 26800 | 26807 | 26813 | 1 \| 1 |
| 32 | 26820 | 26826 | 26832 | 26839 | 26845 | 26851 | 26858 | 26864 | 26870 | 26877 | 26883 | 26889 | 2 \| 2 |
| 33 | 26896 | 26902 | 26908 | 26915 | 26921 | 26927 | 26933 | 26940 | 26946 | 26952 | 26958 | 26965 | 3 \| 4 |
| 34 | 26971 | 26977 | 26983 | 26989 | 26996 | 27002 | 27008 | 27014 | 27020 | 27027 | 27033 | 27039 | 4 \| 5 |
| 35 | 5.27045 | 27051 | 27057 | 27063 | 27069 | 27076 | 27082 | 27088 | 27094 | 27100 | 27106 | 27112 | s |
| 36 | 27118 | 27124 | 27130 | 27136 | 27142 | 27148 | 27154 | 27160 | 27166 | 27172 | 27178 | 27184 | 1 \| 1 |
| 37 | 27190 | 27196 | 27202 | 27208 | 27214 | 27220 | 27226 | 27232 | 27238 | 27244 | 27250 | 27256 | 2 \| 2 |
| 38 | 27262 | 27268 | 27274 | 27279 | 27285 | 27291 | 27297 | 27303 | 27309 | 27315 | 27320 | 27326 | 3 \| 4 |
| 39 | 27332 | 27338 | 27344 | 27350 | 27355 | 27361 | 27367 | 27373 | 27379 | 27384 | 27390 | 27396 | 4 \| 5 |
| 40 | 5.27402 | 27407 | 27413 | 27419 | 27425 | 27430 | 27436 | 27442 | 27447 | 27453 | 27459 | 27464 | s |
| 41 | 27470 | 27476 | 27481 | 27487 | 27493 | 27498 | 27504 | 27510 | 27515 | 27521 | 27526 | 27532 | 1 \| 1 |
| 42 | 27538 | 27543 | 27549 | 27554 | 27560 | 27566 | 27571 | 27577 | 27582 | 27588 | 27593 | 27599 | 2 \| 2 |
| 43 | 27604 | 27610 | 27615 | 27621 | 27626 | 27632 | 27637 | 27643 | 27648 | 27654 | 27659 | 27665 | 3 \| 3 |
| 44 | 27670 | 27675 | 27681 | 27686 | 27692 | 27697 | 27703 | 27708 | 27713 | 27719 | 27724 | 27729 | 4 \| 4 |
| 45 | 5.27735 | 27740 | 27746 | 27751 | 27756 | 27762 | 27767 | 27772 | 27777 | 27783 | 27788 | 27793 | s |
| 46 | 27799 | 27804 | 27809 | 27815 | 27820 | 27825 | 27830 | 27836 | 27841 | 27846 | 27851 | 27856 | 1 \| 1 |
| 47 | 27862 | 27867 | 27872 | 27877 | 27882 | 27888 | 27893 | 27898 | 27903 | 27908 | 27913 | 27919 | 2 \| 2 |
| 48 | 27924 | 27929 | 27934 | 27939 | 27944 | 27949 | 27954 | 27959 | 27964 | 27970 | 27975 | 27980 | 3 \| 3 |
| 49 | 27985 | 27990 | 27995 | 28000 | 28005 | 28010 | 28015 | 28020 | 28025 | 28030 | 28035 | 28040 | 4 \| 4 |
| 50 | 5.28045 | 28050 | 28055 | 28060 | 28065 | 28070 | 28075 | 28080 | 28085 | 28090 | 28094 | 28099 | s |
| 51 | 28104 | 28109 | 28114 | 28119 | 28124 | 28129 | 28134 | 28138 | 28143 | 28148 | 28153 | 28158 | 1 \| 1 |
| 52 | 28163 | 28168 | 28172 | 28177 | 28182 | 28187 | 28191 | 28196 | 28201 | 28206 | 28211 | 28215 | 2 \| 2 |
| 53 | 28220 | 28225 | 28230 | 28234 | 28239 | 28244 | 28249 | 28253 | 28258 | 28263 | 28267 | 28272 | 3 \| 3 |
| 54 | 28277 | 28281 | 28286 | 28291 | 28295 | 28300 | 28305 | 28309 | 28314 | 28319 | 28323 | 28328 | 4 \| 4 |
| 55 | 5.28332 | 28337 | 28342 | 28346 | 28351 | 28355 | 28360 | 28364 | 28369 | 28374 | 28378 | 28383 | s |
| 56 | 28387 | 28392 | 28396 | 28401 | 28405 | 28410 | 28414 | 28419 | 28423 | 28428 | 28432 | 28437 | 1 \| 1 |
| 57 | 28441 | 28446 | 28450 | 28454 | 28459 | 28463 | 28468 | 28472 | 28476 | 28481 | 28485 | 28490 | 2 \| 2 |
| 58 | 28494 | 28498 | 28503 | 28507 | 28512 | 28516 | 28520 | 28525 | 28529 | 28533 | 28538 | 28542 | 3 \| 2 |
| 59 | 28546 | 28551 | 28555 | 28559 | 28563 | 28568 | 28572 | 28576 | 28580 | 28585 | 28589 | 28593 | 4 \| 3 |

# TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

## 5 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.28597 | 28602 | 28606 | 28610 | 28614 | 28619 | 28623 | 28627 | 28631 | 28635 | 28639 | 28644 | s |
| 1 | 28648 | 28652 | 28656 | 28660 | 28664 | 28668 | 28673 | 28677 | 28681 | 28685 | 28689 | 28693 | 1 \| 1 |
| 2 | 28697 | 28701 | 28705 | 28709 | 28713 | 28718 | 28722 | 28726 | 28730 | 28734 | 28738 | 28742 | 2 \| 2 |
| 3 | 28746 | 28750 | 28754 | 28758 | 28762 | 28766 | 28770 | 28774 | 28778 | 28782 | 28786 | 28790 | 3 \| 2 |
| 4 | 28793 | 28797 | 28801 | 28805 | 28809 | 28813 | 28817 | 28821 | 28825 | 28829 | 28832 | 28836 | 4 \| 3 |
| 5 | 5.28840 | 28844 | 28848 | 28852 | 28856 | 28860 | 28863 | 28867 | 28871 | 28875 | 28879 | 28882 | s |
| 6 | 28886 | 28890 | 28894 | 28898 | 28901 | 28905 | 28909 | 28913 | 28916 | 28920 | 28924 | 28928 | 1 \| 1 |
| 7 | 28931 | 28935 | 28939 | 28942 | 28946 | 28950 | 28953 | 28957 | 28961 | 28964 | 28968 | 28972 | 2 \| 2 |
| 8 | 28975 | 28979 | 28983 | 28986 | 28990 | 28994 | 28997 | 29001 | 29004 | 29008 | 29012 | 29015 | 3 \| 2 |
| 9 | 29019 | 29022 | 29026 | 29029 | 29033 | 29037 | 29040 | 29044 | 29047 | 29051 | 29054 | 29058 | 4 \| 3 |
| 10 | 5.29061 | 29065 | 29068 | 29072 | 29075 | 29079 | 29082 | 29086 | 29089 | 29092 | 29096 | 29099 | s |
| 11 | 29103 | 29106 | 29110 | 29113 | 29116 | 29120 | 29123 | 29127 | 29130 | 29133 | 29137 | 29140 | 1 \| 1 |
| 12 | 29143 | 29147 | 29150 | 29154 | 29157 | 29160 | 29163 | 29167 | 29170 | 29173 | 29177 | 29180 | 2 \| 1 |
| 13 | 29183 | 29187 | 29190 | 29193 | 29196 | 29200 | 29203 | 29206 | 29209 | 29213 | 29216 | 29219 | 3 \| 2 |
| 14 | 29222 | 29226 | 29229 | 29232 | 29235 | 29238 | 29241 | 29245 | 29248 | 29251 | 29254 | 29257 | 4 \| 2 |
| 15 | 5.29260 | 29264 | 29267 | 29270 | 29273 | 29276 | 29279 | 29282 | 29285 | 29288 | 29292 | 29295 | s |
| 16 | 29298 | 29301 | 29304 | 29307 | 29310 | 29313 | 29316 | 29319 | 29322 | 29325 | 29328 | 29331 | 1 \| 1 |
| 17 | 29334 | 29337 | 29340 | 29343 | 29346 | 29349 | 29352 | 29355 | 29358 | 29361 | 29364 | 29367 | 2 \| 1 |
| 18 | 29370 | 29373 | 29375 | 29378 | 29381 | 29384 | 29387 | 29390 | 29393 | 29396 | 29399 | 29401 | 3 \| 2 |
| 19 | 29404 | 29407 | 29410 | 29413 | 29416 | 29419 | 29421 | 29424 | 29427 | 29430 | 29433 | 29435 | 4 \| 2 |
| 20 | 5.29438 | 29441 | 29444 | 29447 | 29449 | 29452 | 29455 | 29458 | 29460 | 29463 | 29166 | 29468 | s |
| 21 | 29471 | 29474 | 29477 | 29479 | 29482 | 29485 | 29487 | 29490 | 29493 | 29495 | 29498 | 29501 | 1 \| 1 |
| 22 | 29503 | 29506 | 29509 | 29511 | 29514 | 29516 | 29519 | 29522 | 29524 | 29527 | 29529 | 29532 | 2 \| 1 |
| 23 | 29535 | 29537 | 29540 | 29542 | 29545 | 29547 | 29550 | 29552 | 29555 | 29558 | 29560 | 29563 | 3 \| 2 |
| 24 | 29565 | 29568 | 29570 | 29573 | 29575 | 29577 | 29580 | 29582 | 29585 | 29587 | 29590 | 29592 | 4 \| 2 |
| 25 | 5.29595 | 29597 | 29599 | 29602 | 29604 | 29607 | 29609 | 29611 | 29614 | 29616 | 29619 | 29621 | s |
| 26 | 29623 | 29626 | 29628 | 29630 | 29633 | 29635 | 29637 | 29640 | 29642 | 29644 | 29647 | 29649 | 1 \| 0 |
| 27 | 29651 | 29654 | 29656 | 29658 | 29660 | 29663 | 29665 | 29667 | 29669 | 29672 | 29674 | 29676 | 2 \| 1 |
| 28 | 29678 | 29681 | 29683 | 29685 | 29687 | 29689 | 29691 | 29694 | 29696 | 29698 | 29700 | 29702 | 3 \| 1 |
| 29 | 29704 | 29707 | 29709 | 29711 | 29713 | 29715 | 29717 | 29719 | 29721 | 29724 | 29726 | 29728 | 4 \| 2 |
| 30 | 5.29730 | 29732 | 29734 | 29736 | 29738 | 29740 | 29742 | 29744 | 29746 | 29748 | 29750 | 29752 | s |
| 31 | 29754 | 29756 | 29758 | 29760 | 29762 | 29764 | 29766 | 29768 | 29770 | 29772 | 29774 | 29776 | 1 \| 0 |
| 32 | 29778 | 29780 | 29782 | 29784 | 29786 | 29788 | 29790 | 29791 | 29793 | 29795 | 29797 | 29799 | 2 \| 1 |
| 33 | 29801 | 29803 | 29805 | 29807 | 29808 | 29810 | 29812 | 29814 | 29816 | 29818 | 29819 | 29821 | 3 \| 1 |
| 34 | 29823 | 29825 | 29827 | 29828 | 29830 | 29832 | 29834 | 29835 | 29837 | 29839 | 29841 | 29842 | 4 \| 2 |
| 35 | 5.29844 | 29846 | 29848 | 29849 | 29851 | 29853 | 29854 | 29856 | 29858 | 29859 | 29861 | 29863 | s |
| 36 | 29864 | 29866 | 29868 | 29869 | 29871 | 29873 | 29874 | 29876 | 29878 | 29879 | 29881 | 29882 | 1 \| 0 |
| 37 | 29884 | 29886 | 29887 | 29889 | 29890 | 29892 | 29893 | 29895 | 29896 | 29898 | 29900 | 29901 | 2 \| 1 |
| 38 | 29903 | 29904 | 29906 | 29907 | 29909 | 29910 | 29912 | 29913 | 29915 | 29916 | 29918 | 29919 | 3 \| 1 |
| 39 | 29920 | 29922 | 29923 | 29925 | 29926 | 29928 | 29929 | 29930 | 29932 | 29933 | 29935 | 29936 | 4 \| 2 |
| 40 | 5.29937 | 29939 | 29940 | 29942 | 29943 | 29944 | 29946 | 29947 | 29948 | 29950 | 29951 | 29952 | s |
| 41 | 29954 | 29955 | 29956 | 29958 | 29959 | 29960 | 29961 | 29963 | 29964 | 29965 | 29966 | 29968 | 1 \| 0 |
| 42 | 29969 | 29970 | 29971 | 29973 | 29974 | 29975 | 29976 | 29978 | 29979 | 29980 | 29981 | 29982 | 2 \| 0 |
| 43 | 29983 | 29985 | 29986 | 29987 | 29988 | 29989 | 29990 | 29992 | 29993 | 29994 | 29995 | 29996 | 3 \| 1 |
| 44 | 29997 | 29998 | 29999 | 30000 | 30001 | 30003 | 30001 | 30005 | 30006 | 30007 | 30008 | 30009 | 4 \| 1 |
| 45 | 5.30010 | 30011 | 30012 | 30013 | 30014 | 30015 | 30016 | 30017 | 30018 | 30019 | 30020 | 30021 | s |
| 46 | 30022 | 30023 | 30024 | 30025 | 30026 | 30027 | 30028 | 30029 | 30029 | 30030 | 30031 | 30032 | 1 \| 0 |
| 47 | 30033 | 30034 | 30035 | 30036 | 30037 | 30038 | 30038 | 30039 | 30040 | 30041 | 30042 | 30043 | 2 \| 0 |
| 48 | 30043 | 30044 | 30045 | 30046 | 30047 | 30048 | 30048 | 30049 | 30050 | 30051 | 30051 | 30052 | 3 \| 1 |
| 49 | 30053 | 30054 | 30054 | 30055 | 30056 | 30057 | 30057 | 30058 | 30059 | 30060 | 30060 | 30061 | 4 \| 1 |
| 50 | 5.30062 | 30062 | 30063 | 30064 | 30064 | 30065 | 30066 | 30066 | 30067 | 30068 | 30068 | 30069 | s |
| 51 | 30070 | 30070 | 30071 | 30071 | 30072 | 30073 | 30073 | 30074 | 30074 | 30075 | 30075 | 30076 | 1 \| 0 |
| 52 | 30077 | 30077 | 30078 | 30078 | 30079 | 30079 | 30080 | 30080 | 30081 | 30081 | 30082 | 30082 | 2 \| 0 |
| 53 | 30083 | 30083 | 30084 | 30084 | 30085 | 30085 | 30086 | 30086 | 30086 | 30087 | 30087 | 30088 | 3 \| 0 |
| 54 | 30088 | 30089 | 30089 | 30089 | 30090 | 30090 | 30090 | 30090 | 30091 | 30091 | 30092 | 30092 | 4 \| 1 |
| 55 | 5.30093 | 30093 | 30093 | 30094 | 30094 | 30094 | 30095 | 30095 | 30095 | 30096 | 30096 | 30096 | s |
| 56 | 30096 | 30097 | 30097 | 30097 | 30097 | 30098 | 30098 | 30098 | 30098 | 30099 | 30099 | 30099 | 1 \| 0 |
| 57 | 30099 | 30100 | 30100 | 30100 | 30100 | 30100 | 30100 | 30101 | 30101 | 30101 | 30101 | 30101 | 2 \| 0 |
| 58 | 30101 | 30102 | 30102 | 30102 | 30102 | 30102 | 30102 | 30102 | 30102 | 30102 | 30102 | 30102 | 3 \| 0 |
| 59 | 30103 | 30103 | 30103 | 30103 | 30103 | 30103 | 30103 | 30103 | 30103 | 30103 | 30103 | 30103 | 4 \| 1 |

# TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## RISING.

### 0 Hour.

| M | 0ᵐ | 5ᵐ | 10ᵐ | 15ᵐ | 20ᵐ | 25ᵐ | 30ᵐ | 35ᵐ | 40ᵐ | 45ᵐ | 50ᵐ | 55ᵐ | Pro. pts. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9. | | | | 02436 | 21818 | 37654 | 51044 | 62642 | 72873 | 82024 | 90303 | | |
| 1 | ⅛.97860 | 04813 | 11250 | 17242 | 22848 | 28114 | 33079 | 37775 | 42230 | 46468 | 50509 | 54370 | | |
| 2 | 0.58066 | 61612 | 65019 | 68297 | 71455 | 74503 | 77448 | 80296 | 83054 | 85726 | 88319 | 90837 | | |
| 3 | ⅛.93284 | 95664 | 97980 | 00236 | 02435 | 04580 | 06673 | 08717 | 10714 | 12666 | 14575 | 16443 | | |
| 4 | 1.18271 | 20062 | 21817 | 23537 | 25224 | 26878 | 28502 | 30095 | 31660 | 33198 | 34708 | 36193 | | |
| 5 | 1.37653 | 39088 | 40501 | 41890 | 43258 | 44605 | 45931 | 47237 | 48524 | 49792 | 51041 | 52273 | | |
| 6 | 53488 | 54686 | 55868 | 57034 | 58184 | 59320 | 60440 | 61547 | 62639 | 63718 | 64784 | 65837 | | |
| 7 | 66877 | 67905 | 68920 | 69924 | 70917 | 71898 | 72869 | 73829 | 74778 | 75717 | 76646 | 77565 | | |
| 8 | 78474 | 79374 | 80265 | 81147 | 82019 | 82884 | 83739 | 84587 | 85426 | 86257 | 87080 | 87896 | | |
| 9 | 88703 | 89504 | 90297 | 91083 | 91862 | 92634 | 93399 | 94157 | 94909 | 95655 | 96394 | 97127 | | |
| 10 | ½.97854 | 98574 | 99289 | 99998 | 00701 | 01399 | 02091 | 02777 | 03458 | 04134 | 04805 | 05470 | s | |
| 11 | 2.06131 | 06786 | 07437 | 08082 | 08723 | 09359 | 09991 | 10618 | 11240 | 11859 | 12472 | 13082 | 1 | 119 |
| 12 | 13687 | 14288 | 14885 | 15477 | 16066 | 16651 | 17232 | 17809 | 18382 | 18951 | 19517 | 20079 | 2 | 238 |
| 13 | 20638 | 21192 | 21744 | 22292 | 22836 | 23377 | 23915 | 24449 | 24980 | 25508 | 26033 | 26554 | 3 | 368 |
| 14 | 27073 | 27588 | 28100 | 28609 | 29116 | 29619 | 30120 | 30617 | 31112 | 31604 | 32093 | 32579 | 4 | 476 |
| 15 | 2.33063 | 33544 | 34023 | 34498 | 34972 | 35442 | 35910 | 36376 | 36839 | 37299 | 37758 | 38213 | s | |
| 16 | 38667 | 39118 | 39567 | 40013 | 40457 | 40899 | 41339 | 41776 | 42211 | 42644 | 43075 | 43504 | 1 | 84 |
| 17 | 43930 | 44355 | 44777 | 45198 | 45616 | 46033 | 46447 | 46859 | 47270 | 47678 | 48085 | 48490 | 2 | 168 |
| 18 | 48893 | 49294 | 49693 | 50090 | 50486 | 50879 | 51271 | 51661 | 52050 | 52436 | 52821 | 53205 | 3 | 252 |
| 19 | 53586 | 53966 | 54344 | 54721 | 55096 | 55469 | 55841 | 56211 | 56580 | 56947 | 57313 | 57676 | 4 | 336 |
| 20 | 2.58039 | 58400 | 58759 | 59117 | 59474 | 59829 | 60182 | 60534 | 60885 | 61234 | 61582 | 61929 | s | |
| 21 | 62274 | 62618 | 62960 | 63302 | 63641 | 63979 | 64316 | 64652 | 64987 | 65320 | 65652 | 65982 | 1 | 65 |
| 22 | 66312 | 66640 | 66967 | 67292 | 67617 | 67940 | 68262 | 68583 | 68903 | 69221 | 69538 | 69855 | 2 | 130 |
| 23 | 70170 | 70483 | 70796 | 71108 | 71418 | 71728 | 72036 | 72343 | 72649 | 72954 | 73258 | 73561 | 3 | 195 |
| 24 | 73863 | 74164 | 74464 | 74762 | 75060 | 75357 | 75652 | 75947 | 76241 | 76533 | 76825 | 77116 | 4 | 260 |
| 25 | 2.77405 | 77694 | 77982 | 78269 | 78555 | 78840 | 79124 | 79407 | 79689 | 79970 | 80251 | 80530 | s | |
| 26 | 80809 | 81086 | 81363 | 81639 | 81914 | 82188 | 82461 | 82734 | 83005 | 83276 | 83546 | 83815 | 1 | 53 |
| 27 | 84083 | 84350 | 84617 | 84883 | 85148 | 85412 | 85675 | 85937 | 86199 | 86460 | 86720 | 86979 | 2 | 106 |
| 28 | 87238 | 87496 | 87753 | 88009 | 88265 | 88519 | 88773 | 89027 | 89279 | 89531 | 89782 | 90032 | 3 | 159 |
| 29 | 90282 | 90531 | 90779 | 91027 | 91273 | 91520 | 91765 | 92010 | 92254 | 92497 | 92739 | 92981 | 4 | 212 |
| 30 | 2.93223 | 93463 | 93703 | 93942 | 94181 | 94419 | 94656 | 94893 | 95129 | 95364 | 95599 | 95833 | s | |
| 31 | 96067 | 96299 | 96532 | 96763 | 96994 | 97224 | 97454 | 97683 | 97912 | 98140 | 98367 | 98594 | 1 | 45 |
| 32 | ⅛.98820 | 99045 | 99270 | 99495 | 99719 | 99942 | 00164 | 00386 | 00608 | 00829 | 01049 | 01269 | 2 | 90 |
| 33 | 3.01488 | 01707 | 01925 | 02143 | 02360 | 02576 | 02792 | 03008 | 03222 | 03437 | 03651 | 03864 | 3 | 134 |
| 34 | 04077 | 04289 | 04501 | 04712 | 04922 | 05133 | 05342 | 05551 | 05760 | 05968 | 06176 | 06383 | 4 | 178 |
| 35 | 3.06590 | 06796 | 07001 | 07207 | 07411 | 07616 | 07819 | 08023 | 08225 | 08428 | 08629 | 08831 | s | |
| 36 | 09032 | 09232 | 09432 | 09632 | 09831 | 10029 | 10227 | 10425 | 10622 | 10819 | 11015 | 11211 | 1 | 39 |
| 37 | 11406 | 11601 | 11796 | 11990 | 12184 | 12377 | 12570 | 12762 | 12954 | 13146 | 13337 | 13527 | 2 | 77 |
| 38 | 13718 | 13908 | 14097 | 14286 | 14475 | 14663 | 14850 | 15038 | 15225 | 15411 | 15597 | 15783 | 3 | 116 |
| 39 | 15969 | 16154 | 16338 | 16522 | 16706 | 16889 | 17072 | 17255 | 17437 | 17619 | 17800 | 17982 | 4 | 154 |
| 40 | 3.18162 | 18343 | 18522 | 18702 | 18881 | 19060 | 19238 | 19417 | 19594 | 19771 | 19949 | 20125 | s | |
| 41 | 20301 | 20477 | 20653 | 20828 | 21003 | 21177 | 21351 | 21525 | 21699 | 21872 | 22044 | 22217 | 1 | 34 |
| 42 | 22389 | 22560 | 22732 | 22903 | 23073 | 23244 | 23414 | 23583 | 23753 | 23922 | 24090 | 24259 | 2 | 68 |
| 43 | 24427 | 24594 | 24762 | 24929 | 25095 | 25262 | 25428 | 25594 | 25759 | 25924 | 26089 | 26253 | 3 | 102 |
| 44 | 26418 | 26581 | 26745 | 26908 | 27071 | 27234 | 27396 | 27558 | 27720 | 27881 | 28042 | 28203 | 4 | 137 |
| 45 | 3.28363 | 28524 | 28683 | 28843 | 29002 | 29161 | 29320 | 29478 | 29637 | 29794 | 29952 | 30109 | s | |
| 46 | 30266 | 30423 | 30579 | 30735 | 30891 | 31047 | 31202 | 31357 | 31512 | 31666 | 31820 | 31974 | 1 | 31 |
| 47 | 32128 | 32281 | 32434 | 32587 | 32739 | 32892 | 33044 | 33195 | 33347 | 33498 | 33649 | 33800 | 2 | 62 |
| 48 | 33950 | 34100 | 34250 | 34400 | 34549 | 34698 | 34847 | 34995 | 35144 | 35292 | 35439 | 35587 | 3 | 92 |
| 49 | 35734 | 35881 | 36028 | 36175 | 36321 | 36467 | 36613 | 36758 | 36903 | 37048 | 37193 | 37338 | 4 | 122 |
| 50 | 3.37482 | 37626 | 37770 | 37914 | 38057 | 38200 | 38343 | 38486 | 38628 | 38770 | 38912 | 39054 | s | |
| 51 | 39195 | 39336 | 39477 | 39618 | 39759 | 39899 | 40039 | 40179 | 40319 | 40458 | 40597 | 40736 | 1 | 27 |
| 52 | 40875 | 41013 | 41152 | 41290 | 41427 | 41565 | 41702 | 41839 | 41976 | 42113 | 42250 | 42386 | 2 | 55 |
| 53 | 42522 | 42658 | 42794 | 42929 | 43064 | 43199 | 43334 | 43469 | 43603 | 43737 | 43871 | 44005 | 3 | 82 |
| 54 | 44138 | 44272 | 44405 | 44537 | 44670 | 44803 | 44935 | 45067 | 45199 | 45331 | 45462 | 45593 | 4 | 110 |
| 55 | 3.45724 | 45855 | 45986 | 46116 | 46247 | 46377 | 46507 | 46636 | 46766 | 46895 | 47024 | 47153 | s | |
| 56 | 47282 | 47410 | 47539 | 47667 | 47795 | 47923 | 48050 | 48177 | 48305 | 48432 | 48558 | 48685 | 1 | 25 |
| 57 | 48811 | 48938 | 49064 | 49190 | 49315 | 49441 | 49566 | 49691 | 49816 | 49941 | 50066 | 50190 | 2 | 50 |
| 58 | 50314 | 50438 | 50562 | 50686 | 50809 | 50933 | 51056 | 51179 | 51301 | 51424 | 51547 | 51669 | 3 | 75 |
| 59 | 51791 | 51913 | 52035 | 52156 | 52278 | 52399 | 52520 | 52641 | 52761 | 52882 | 53002 | 53122 | 4 | 100 |

## To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

### RISING.

### 1 Hour.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.53243 | 53362 | 53482 | 53602 | 53721 | 53840 | 53959 | 54078 | 54197 | 54315 | 54434 | 54552 | s |
| 1 | 54670 | 54788 | 54905 | 55023 | 55140 | 55258 | 55375 | 55492 | 55608 | 55725 | 55841 | 55958 | 1 \| 23 |
| 2 | 56074 | 56190 | 56306 | 56421 | 56537 | 56652 | 56767 | 56882 | 56997 | 57112 | 57226 | 57341 | 2 \| 46 |
| 3 | 57455 | 57569 | 57683 | 57797 | 57910 | 58024 | 58137 | 58250 | 58363 | 58476 | 58589 | 58702 | 3 \| 70 |
| 4 | 58814 | 58926 | 59038 | 59150 | 59262 | 59374 | 59486 | 59597 | 59708 | 59819 | 59930 | 60041 | 4 \| 93 |
| 5 | 3.60152 | 60262 | 60373 | 60483 | 60593 | 60703 | 60813 | 60923 | 61032 | 61143 | 61251 | 61360 | s |
| 6 | 61469 | 61578 | 61686 | 61795 | 61903 | 62012 | 62120 | 62228 | 62336 | 62443 | 62551 | 62659 | 1 \| 21 |
| 7 | 62766 | 62873 | 62980 | 63087 | 63194 | 63301 | 63407 | 63513 | 63620 | 63726 | 63832 | 63938 | 2 \| 42 |
| 8 | 64043 | 64149 | 64254 | 64360 | 64465 | 64570 | 64675 | 64780 | 64885 | 64989 | 65094 | 65198 | 3 \| 63 |
| 9 | 65302 | 65406 | 65510 | 65614 | 65717 | 65821 | 65924 | 66028 | 66131 | 66234 | 66337 | 66440 | 4 \| 85 |
| 10 | 3.66542 | 66645 | 66747 | 66849 | 66952 | 67054 | 67156 | 67257 | 67359 | 67461 | 67562 | 67663 | s |
| 11 | 67765 | 67866 | 67967 | 68067 | 68168 | 68269 | 68369 | 68469 | 68570 | 68670 | 68770 | 68870 | 1 \| 20 |
| 12 | 68969 | 69069 | 69169 | 69268 | 69367 | 69467 | 69566 | 69665 | 69763 | 69862 | 69961 | 70059 | 2 \| 40 |
| 13 | 70158 | 70256 | 70354 | 70452 | 70550 | 70648 | 70745 | 70843 | 70940 | 71038 | 71135 | 71232 | 3 \| 60 |
| 14 | 71329 | 71426 | 71523 | 71620 | 71716 | 71813 | 71909 | 72005 | 72101 | 72197 | 72294 | 72389 | 4 \| 80 |
| 15 | 3.72485 | 72580 | 72676 | 72771 | 72867 | 72962 | 73057 | 73152 | 73247 | 73341 | 73436 | 73530 | s |
| 16 | 73625 | 73719 | 73813 | 73907 | 74001 | 74095 | 74189 | 74283 | 74376 | 74470 | 74563 | 74657 | 1 \| 18 |
| 17 | 74750 | 74843 | 74936 | 75029 | 75121 | 75214 | 75307 | 75399 | 75491 | 75584 | 75676 | 75768 | 2 \| 37 |
| 18 | 75860 | 75952 | 76043 | 76135 | 76227 | 76318 | 76409 | 76501 | 76592 | 76683 | 76774 | 76865 | 3 \| 55 |
| 19 | 76955 | 77046 | 77137 | 77227 | 77318 | 77408 | 77498 | 77588 | 77678 | 77768 | 77858 | 77947 | 4 \| 74 |
| 20 | 3.78037 | 78127 | 78216 | 78305 | 78395 | 78484 | 78573 | 78662 | 78750 | 78839 | 78928 | 79016 | s |
| 21 | 79105 | 79193 | 79282 | 79370 | 79458 | 79546 | 79634 | 79722 | 79809 | 79897 | 79985 | 80072 | 1 \| 17 |
| 22 | 80159 | 80247 | 80334 | 80421 | 80508 | 80595 | 80682 | 80768 | 80855 | 80942 | 81028 | 81115 | 2 \| 35 |
| 23 | 81201 | 81287 | 81373 | 81459 | 81545 | 81631 | 81717 | 81802 | 81888 | 81974 | 82059 | 82144 | 3 \| 52 |
| 24 | 82230 | 82315 | 82400 | 82485 | 82570 | 82655 | 82739 | 82824 | 82908 | 82993 | 83077 | 83162 | 4 \| 70 |
| 25 | 3.83246 | 83330 | 83414 | 83498 | 83582 | 83666 | 83749 | 83833 | 83917 | 84000 | 84083 | 84167 | s |
| 26 | 84250 | 84333 | 84416 | 84499 | 84582 | 84665 | 84748 | 84830 | 84913 | 84995 | 85078 | 85160 | 1 \| 16 |
| 27 | 85242 | 85324 | 85406 | 85488 | 85570 | 85652 | 85734 | 85816 | 85897 | 85979 | 86060 | 86141 | 2 \| 33 |
| 28 | 86223 | 86304 | 86385 | 86466 | 86547 | 86628 | 86709 | 86790 | 86870 | 86951 | 87031 | 87112 | 3 \| 49 |
| 29 | 87192 | 87272 | 87352 | 87433 | 87513 | 87593 | 87672 | 87752 | 87832 | 87912 | 87991 | 88071 | 4 \| 65 |
| 30 | 3.88150 | 88229 | 88309 | 88388 | 88467 | 88546 | 88625 | 88704 | 88783 | 88862 | 88940 | 89019 | s |
| 31 | 89097 | 89176 | 89254 | 89333 | 89411 | 89489 | 89567 | 89645 | 89723 | 89801 | 89879 | 89956 | 1 \| 15 |
| 32 | 90034 | 90112 | 90189 | 90267 | 90344 | 90421 | 90498 | 90576 | 90653 | 90730 | 90807 | 90884 | 2 \| 31 |
| 33 | 90960 | 91037 | 91114 | 91190 | 91267 | 91343 | 91420 | 91496 | 91572 | 91648 | 91724 | 91800 | 3 \| 46 |
| 34 | 91876 | 91952 | 92028 | 92104 | 92179 | 92255 | 92331 | 92406 | 92482 | 92557 | 92632 | 92707 | 4 \| 62 |
| 35 | 3.92782 | 92858 | 92933 | 93007 | 93082 | 93157 | 93232 | 93306 | 93381 | 93456 | 93530 | 93605 | s |
| 36 | 93679 | 93753 | 93827 | 93901 | 93975 | 94049 | 94123 | 94197 | 94271 | 94345 | 94418 | 94492 | 1 \| 15 |
| 37 | 94566 | 94639 | 94712 | 94786 | 94859 | 94932 | 95005 | 95078 | 95152 | 95224 | 95297 | 95370 | 2 \| 29 |
| 38 | 95443 | 95515 | 95588 | 95661 | 95733 | 95806 | 95878 | 95950 | 96023 | 96095 | 96167 | 96239 | 3 \| 44 |
| 39 | 96311 | 96383 | 96455 | 96527 | 96599 | 96670 | 96742 | 96813 | 96885 | 96956 | 97028 | 97099 | 4 \| 58 |
| 40 | 3.97170 | 97242 | 97313 | 97384 | 97455 | 97526 | 97597 | 97667 | 97738 | 97809 | 97880 | 97950 | s |
| 41 | 98021 | 98091 | 98162 | 98232 | 98302 | 98372 | 98443 | 98513 | 98583 | 98653 | 98723 | 98793 | 1 \| 14 |
| 42 | 98862 | 98932 | 99002 | 99072 | 99141 | 99211 | 99280 | 99350 | 99419 | 99488 | 99557 | 99627 | 2 \| 28 |
| 43 | ½ 99696 | 99765 | 99834 | 99903 | 99972 | 00040 | 00109 | 00178 | 00247 | 00315 | 00384 | 00452 | 3 \| 42 |
| 44 | 4.00521 | 00589 | 00657 | 00726 | 00794 | 00862 | 00930 | 00998 | 01066 | 01134 | 01202 | 01270 | 4 \| 56 |
| 45 | 4.01337 | 01405 | 01473 | 01540 | 01608 | 01675 | 01743 | 01810 | 01877 | 01945 | 02012 | 02079 | s |
| 46 | 02146 | 02213 | 02280 | 02347 | 02414 | 02481 | 02547 | 02614 | 02681 | 02747 | 02814 | 02880 | 1 \| 13 |
| 47 | 02947 | 03013 | 03080 | 03146 | 03212 | 03278 | 03344 | 03411 | 03477 | 03542 | 03608 | 03674 | 2 \| 26 |
| 48 | 03740 | 03806 | 03871 | 03937 | 04003 | 04068 | 04134 | 04199 | 04265 | 04330 | 04395 | 04460 | 3 \| 40 |
| 49 | 04526 | 04591 | 04656 | 04721 | 04786 | 04851 | 04916 | 04980 | 05045 | 05110 | 05175 | 05239 | 4 \| 53 |
| 50 | 4.05304 | 05368 | 05433 | 05497 | 05561 | 05626 | 05690 | 05754 | 05818 | 05882 | 05946 | 06010 | s |
| 51 | 06074 | 06138 | 06202 | 06266 | 06330 | 06393 | 06457 | 06521 | 06584 | 06648 | 06711 | 06775 | 1 \| 13 |
| 52 | 06838 | 06901 | 06965 | 07028 | 07091 | 07154 | 07217 | 07280 | 07343 | 07406 | 07469 | 07532 | 2 \| 25 |
| 53 | 07595 | 07657 | 07720 | 07783 | 07845 | 07908 | 07970 | 08033 | 08095 | 08157 | 08220 | 08282 | 3 \| 38 |
| 54 | 08344 | 08406 | 08468 | 08530 | 08592 | 08654 | 08716 | 08778 | 08840 | 08902 | 08964 | 09025 | 4 \| 50 |
| 55 | 4.09087 | 09148 | 09210 | 09272 | 09333 | 09394 | 09456 | 09517 | 09578 | 09640 | 09701 | 09762 | s |
| 56 | 09823 | 09884 | 09945 | 10006 | 10067 | 10128 | 10188 | 10249 | 10310 | 10371 | 10431 | 10492 | 1 \| 12 |
| 57 | 10552 | 10613 | 10673 | 10734 | 10794 | 10854 | 10915 | 10975 | 11035 | 11095 | 11155 | 11215 | 2 \| 24 |
| 58 | 11275 | 11335 | 11395 | 11455 | 11515 | 11575 | 11634 | 11694 | 11754 | 11813 | 11873 | 11932 | 3 \| 36 |
| 59 | 11992 | 12051 | 12111 | 12170 | 12229 | 12289 | 12348 | 12407 | 12466 | 12525 | 12584 | 12643 | 4 \| 48 |

# TABLE XXIX.

## To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

### RISING.

### 2 Hours.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4.12702 | 12761 | 12820 | 12879 | 12938 | 12996 | 13055 | 13114 | 13172 | 13231 | 13289 | 13348 | s |
| 1 | 13406 | 13465 | 13523 | 13581 | 13640 | 13698 | 13756 | 13814 | 13872 | 13931 | 13989 | 14047 | 1 \| 11 |
| 2 | 14104 | 14162 | 14220 | 14278 | 14336 | 14394 | 14451 | 14508 | 14567 | 14625 | 14682 | 14739 | 2 \| 23 |
| 3 | 14797 | 14854 | 14911 | 14969 | 15026 | 15083 | 15140 | 15196 | 15255 | 15312 | 15369 | 15426 | 3 \| 34 |
| 4 | 15483 | 15540 | 15597 | 15653 | 15710 | 15767 | 15824 | 15880 | 15937 | 15994 | 16050 | 16107 | 4 \| 46 |
| 5 | 4.16163 | 16220 | 16276 | 16332 | 16389 | 16445 | 16501 | 16557 | 16614 | 16670 | 16726 | 16782 | s |
| 6 | 16838 | 16894 | 16950 | 17006 | 17062 | 17117 | 17173 | 17229 | 17285 | 17340 | 17396 | 17451 | 1 \| 11 |
| 7 | 17507 | 17563 | 17618 | 17673 | 17729 | 17784 | 17840 | 17895 | 17950 | 18005 | 18060 | 18116 | 2 \| 22 |
| 8 | 18171 | 18226 | 18281 | 18336 | 18391 | 18445 | 18500 | 18555 | 18610 | 18665 | 18719 | 18774 | 3 \| 33 |
| 9 | 18829 | 18883 | 18938 | 18992 | 19047 | 19101 | 19156 | 19210 | 19265 | 19319 | 19373 | 19427 | 4 \| 44 |
| 10 | 4.19482 | 19536 | 19590 | 19644 | 19698 | 19752 | 19806 | 19860 | 19914 | 19968 | 20022 | 20075 | s |
| 11 | 20129 | 20183 | 20236 | 20290 | 20344 | 20397 | 20451 | 20505 | 20558 | 20611 | 20665 | 20718 | 1 \| 11 |
| 12 | 20771 | 20825 | 20878 | 20931 | 20984 | 21037 | 21091 | 21144 | 21197 | 21250 | 21303 | 21356 | 2 \| 21 |
| 13 | 21409 | 21461 | 21514 | 21567 | 21620 | 21673 | 21725 | 21778 | 21831 | 21883 | 21936 | 21988 | 3 \| 32 |
| 14 | 22041 | 22093 | 22146 | 22198 | 22250 | 22303 | 22355 | 22407 | 22459 | 22511 | 22564 | 22616 | 4 \| 42 |
| 15 | 4.22668 | 22720 | 22772 | 22824 | 22876 | 22928 | 22980 | 23031 | 23083 | 23135 | 23187 | 23238 | s |
| 16 | 23290 | 23342 | 23393 | 23445 | 23496 | 23548 | 23599 | 23651 | 23702 | 23754 | 23805 | 23856 | 1 \| 10 |
| 17 | 23907 | 23959 | 24010 | 24061 | 24112 | 24163 | 24214 | 24265 | 24316 | 24367 | 24418 | 24469 | 2 \| 20 |
| 18 | 24520 | 24571 | 24622 | 24673 | 24723 | 24774 | 24825 | 24875 | 24926 | 24977 | 25027 | 25078 | 3 \| 31 |
| 19 | 25128 | 25178 | 25229 | 25279 | 25330 | 25380 | 25430 | 25481 | 25531 | 25581 | 25631 | 25681 | 4 \| 41 |
| 20 | 4.25731 | 25781 | 25831 | 25881 | 25931 | 25981 | 26031 | 26081 | 26131 | 26181 | 26231 | 26281 | s |
| 21 | 26330 | 26380 | 26429 | 26479 | 26529 | 26578 | 26628 | 26677 | 26727 | 26776 | 26826 | 26875 | 1 \| 10 |
| 22 | 26924 | 26974 | 27023 | 27072 | 27121 | 27171 | 27220 | 27269 | 27318 | 27367 | 27416 | 27465 | 2 \| 20 |
| 23 | 27514 | 27563 | 27612 | 27661 | 27710 | 27759 | 27807 | 27856 | 27905 | 27954 | 28002 | 28051 | 3 \| 29 |
| 24 | 28099 | 28148 | 28197 | 28245 | 28294 | 28342 | 28391 | 28439 | 28487 | 28536 | 28584 | 28632 | 4 \| 39 |
| 25 | 4.28681 | 28729 | 28777 | 28825 | 28873 | 28921 | 28969 | 29017 | 29066 | 29114 | 29161 | 29209 | s |
| 26 | 29257 | 29305 | 29353 | 29401 | 29449 | 29496 | 29544 | 29592 | 29639 | 29687 | 29735 | 29782 | 1 \| 10 |
| 27 | 29830 | 29877 | 29925 | 29973 | 30020 | 30067 | 30115 | 30162 | 30209 | 30257 | 30304 | 30351 | 2 \| 19 |
| 28 | 30398 | 30445 | 30493 | 30540 | 30587 | 30634 | 30681 | 30728 | 30775 | 30822 | 30869 | 30916 | 3 \| 29 |
| 29 | 30963 | 31009 | 31056 | 31103 | 31150 | 31197 | 31243 | 31290 | 31337 | 31383 | 31430 | 31476 | 4 \| 38 |
| 30 | 4.31523 | 31569 | 31616 | 31662 | 31709 | 31755 | 31801 | 31848 | 31894 | 31940 | 31987 | 32033 | s |
| 31 | 32079 | 32125 | 32171 | 32217 | 32264 | 32310 | 32356 | 32402 | 32448 | 32494 | 32540 | 32586 | 1 \| 9 |
| 32 | 32631 | 32677 | 32723 | 32769 | 32815 | 32860 | 32906 | 32952 | 32997 | 33043 | 33089 | 33134 | 2 \| 18 |
| 33 | 33180 | 33225 | 33271 | 33316 | 33362 | 33407 | 33453 | 33498 | 33543 | 33589 | 33634 | 33679 | 3 \| 28 |
| 34 | 33724 | 33770 | 33815 | 33860 | 33905 | 33950 | 33995 | 34040 | 34085 | 34130 | 34175 | 34220 | 4 \| 37 |
| 35 | 4.34265 | 34310 | 34355 | 34400 | 34444 | 34489 | 34534 | 34579 | 34623 | 34668 | 34713 | 34757 | s |
| 36 | 34802 | 34847 | 34891 | 34936 | 34980 | 35025 | 35069 | 35114 | 35158 | 35202 | 35247 | 35291 | 1 \| 9 |
| 37 | 35335 | 35380 | 35424 | 35468 | 35512 | 35556 | 35601 | 35645 | 35689 | 35733 | 35777 | 35821 | 2 \| 18 |
| 38 | 35865 | 35909 | 35953 | 35997 | 36041 | 36085 | 36128 | 36172 | 36216 | 36260 | 36303 | 36347 | 3 \| 27 |
| 39 | 36391 | 36435 | 36478 | 36522 | 36565 | 36609 | 36653 | 36696 | 36740 | 36783 | 36827 | 36870 | 4 \| 36 |
| 40 | 4.36913 | 36957 | 37000 | 37043 | 37087 | 37130 | 37173 | 37216 | 37260 | 37303 | 37346 | 37389 | s |
| 41 | 37432 | 37475 | 37518 | 37561 | 37604 | 37647 | 37690 | 37733 | 37776 | 37819 | 37862 | 37905 | 1 \| 9 |
| 42 | 37948 | 37990 | 38033 | 38076 | 38119 | 38161 | 38204 | 38247 | 38289 | 38332 | 38374 | 38417 | 2 \| 17 |
| 43 | 38460 | 38502 | 38545 | 38587 | 38629 | 38672 | 38714 | 38757 | 38799 | 38841 | 38884 | 38926 | 3 \| 26 |
| 44 | 38968 | 39010 | 39052 | 39095 | 39137 | 39179 | 39221 | 39263 | 39305 | 39347 | 39389 | 39431 | 4 \| 35 |
| 45 | 4.39473 | 39515 | 39557 | 39599 | 39641 | 39683 | 39725 | 39766 | 39808 | 39850 | 39892 | 39933 | s |
| 46 | 39975 | 40017 | 40058 | 40100 | 40142 | 40183 | 40225 | 40266 | 40308 | 40349 | 40391 | 40432 | 1 \| 8 |
| 47 | 40474 | 40515 | 40556 | 40598 | 40639 | 40680 | 40722 | 40763 | 40804 | 40845 | 40887 | 40928 | 2 \| 17 |
| 48 | 40969 | 41010 | 41051 | 41092 | 41133 | 41174 | 41215 | 41256 | 41297 | 41338 | 41379 | 41420 | 3 \| 25 |
| 49 | 41461 | 41502 | 41543 | 41583 | 41624 | 41665 | 41706 | 41746 | 41787 | 41828 | 41868 | 41909 | 4 \| 34 |
| 50 | 4.41950 | 41990 | 42031 | 42071 | 42112 | 42153 | 42193 | 42233 | 42274 | 42314 | 42355 | 42395 | s |
| 51 | 42435 | 42476 | 42516 | 42556 | 42597 | 42637 | 42677 | 42717 | 42758 | 42798 | 42838 | 42878 | 1 \| 8 |
| 52 | 42918 | 42958 | 42998 | 43038 | 43078 | 43118 | 43158 | 43198 | 43238 | 43278 | 43318 | 43358 | 2 \| 16 |
| 53 | 43398 | 43437 | 43477 | 43517 | 43557 | 43597 | 43636 | 43676 | 43716 | 43755 | 43795 | 43835 | 3 \| 24 |
| 54 | 43874 | 43914 | 43953 | 43993 | 44032 | 44072 | 44111 | 44151 | 44190 | 44229 | 44269 | 44308 | 4 \| 32 |
| 55 | 4.44348 | 44387 | 44426 | 44465 | 44505 | 44544 | 44583 | 44622 | 44662 | 44701 | 44740 | 44779 | s |
| 56 | 44818 | 44857 | 44896 | 44935 | 44974 | 45013 | 45052 | 45091 | 45130 | 45169 | 45208 | 45247 | 1 \| 8 |
| 57 | 45286 | 45325 | 45363 | 45402 | 45441 | 45480 | 45518 | 45557 | 45596 | 45634 | 45673 | 45712 | 2 \| 15 |
| 58 | 45750 | 45789 | 45827 | 45866 | 45905 | 45943 | 45982 | 46020 | 46058 | 46097 | 46135 | 46174 | 3 \| 23 |
| 59 | 46212 | 46250 | 46289 | 46327 | 46365 | 46404 | 46442 | 46480 | 46518 | 46556 | 46595 | 46633 | 4 \| 30 |

# TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## RISING.

### 3 Hours.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.46671 | 46709 | 46747 | 46785 | 46823 | 46861 | 46899 | 46937 | 46975 | 47013 | 47051 | 47089 | s |
| 1 | 47127 | 47165 | 47203 | 47241 | 47278 | 47316 | 47354 | 47392 | 47430 | 47467 | 47505 | 47543 | 1 \| 7 |
| 2 | 47580 | 47618 | 47656 | 47693 | 47731 | 47768 | 47806 | 47843 | 47881 | 47918 | 47956 | 47993 | 2 \| 15 |
| 3 | 48031 | 48068 | 48106 | 48143 | 48180 | 48218 | 48255 | 48292 | 48330 | 48367 | 48404 | 48441 | 3 \| 22 |
| 4 | 48479 | 48516 | 48553 | 48590 | 48627 | 48664 | 48701 | 48739 | 48776 | 48813 | 48850 | 48887 | 4 \| 30 |
| 5 | 1.48924 | 48961 | 48998 | 49035 | 49071 | 49108 | 49145 | 49182 | 49219 | 49256 | 49293 | 49329 | s |
| 6 | 49366 | 49403 | 49440 | 49476 | 49513 | 49550 | 49586 | 49623 | 49660 | 49696 | 49733 | 49769 | 1 \| 7 |
| 7 | 49806 | 49842 | 49879 | 49915 | 49952 | 49988 | 50025 | 50061 | 50098 | 50134 | 50170 | 50207 | 2 \| 14 |
| 8 | 50243 | 50279 | 50316 | 50352 | 50388 | 50424 | 50461 | 50497 | 50533 | 50569 | 50605 | 50641 | 3 \| 22 |
| 9 | 50677 | 50714 | 50750 | 50786 | 50822 | 50858 | 50894 | 50930 | 50966 | 51002 | 51038 | 51073 | 4 \| 29 |
| 10 | 1.51109 | 51145 | 51181 | 51217 | 51253 | 51289 | 51324 | 51360 | 51396 | 51432 | 51467 | 51503 | s |
| 11 | 51539 | 51574 | 51610 | 51646 | 51681 | 51717 | 51753 | 51788 | 51824 | 51859 | 51895 | 51930 | 1 \| 7 |
| 12 | 51966 | 52001 | 52037 | 52072 | 52107 | 52143 | 52178 | 52213 | 52249 | 52284 | 52319 | 52355 | 2 \| 14 |
| 13 | 52390 | 52425 | 52461 | 52496 | 52531 | 52566 | 52601 | 52636 | 52672 | 52707 | 52742 | 52777 | 3 \| 21 |
| 14 | 52812 | 52847 | 52882 | 52917 | 52952 | 52987 | 53022 | 53057 | 53092 | 53127 | 53162 | 53197 | 4 \| 28 |
| 15 | 1.53231 | 53266 | 53301 | 53336 | 53371 | 53405 | 53440 | 53475 | 53510 | 53544 | 53579 | 53614 | s |
| 16 | 53648 | 53683 | 53718 | 53752 | 53787 | 53821 | 53856 | 53891 | 53925 | 53960 | 53994 | 54029 | 1 \| 7 |
| 17 | 54063 | 54097 | 54132 | 54166 | 54201 | 54235 | 54269 | 54304 | 54338 | 54372 | 54407 | 54441 | 2 \| 14 |
| 18 | 54475 | 54509 | 54544 | 54578 | 54612 | 54646 | 54680 | 54715 | 54749 | 54783 | 54817 | 54851 | 3 \| 20 |
| 19 | 54885 | 54919 | 54953 | 54987 | 55021 | 55055 | 55089 | 55123 | 55157 | 55191 | 55225 | 55259 | 4 \| 27 |
| 20 | 1.55293 | 55327 | 55360 | 55394 | 55428 | 55462 | 55496 | 55529 | 55563 | 55597 | 55630 | 55664 | s |
| 21 | 55698 | 55732 | 55765 | 55799 | 55832 | 55866 | 55900 | 55933 | 55967 | 56000 | 56034 | 56067 | 1 \| 7 |
| 22 | 56101 | 56134 | 56168 | 56201 | 56235 | 56268 | 56301 | 56335 | 56368 | 56401 | 56435 | 56468 | 2 \| 13 |
| 23 | 56501 | 56534 | 56568 | 56601 | 56635 | 56668 | 56701 | 56734 | 56767 | 56800 | 56834 | 56867 | 3 \| 20 |
| 24 | 56900 | 56933 | 56966 | 56999 | 57032 | 57065 | 57098 | 57131 | 57164 | 57197 | 57230 | 57263 | 4 \| 26 |
| 25 | 1.57296 | 57329 | 57362 | 57395 | 57428 | 57460 | 57493 | 57526 | 57559 | 57592 | 57625 | 57657 | s |
| 26 | 57690 | 57723 | 57755 | 57788 | 57821 | 57854 | 57886 | 57919 | 57951 | 57984 | 58017 | 58049 | 1 \| 6 |
| 27 | 58082 | 58114 | 58147 | 58179 | 58212 | 58244 | 58277 | 58309 | 58342 | 58374 | 58407 | 58439 | 2 \| 13 |
| 28 | 58471 | 58504 | 58536 | 58568 | 58601 | 58633 | 58665 | 58698 | 58730 | 58762 | 58794 | 58827 | 3 \| 19 |
| 29 | 58859 | 58891 | 58923 | 58955 | 58988 | 59020 | 59052 | 59084 | 59116 | 59148 | 59180 | 59212 | 4 \| 26 |
| 30 | 1.59244 | 59276 | 59308 | 59340 | 59372 | 59404 | 59436 | 59468 | 59500 | 59532 | 59564 | 59596 | s |
| 31 | 59627 | 59659 | 59691 | 59723 | 59755 | 59786 | 59818 | 59850 | 59882 | 59913 | 59945 | 59977 | 1 \| 6 |
| 32 | 60008 | 60040 | 60072 | 60103 | 60135 | 60167 | 60198 | 60230 | 60261 | 60293 | 60324 | 60356 | 2 \| 12 |
| 33 | 60388 | 60419 | 60450 | 60482 | 60513 | 60545 | 60576 | 60608 | 60639 | 60670 | 60701 | 60733 | 3 \| 18 |
| 34 | 60764 | 60796 | 60827 | 60858 | 60890 | 60921 | 60952 | 60983 | 61015 | 61046 | 61077 | 61108 | 4 \| 25 |
| 35 | 1.61139 | 61171 | 61202 | 61233 | 61264 | 61295 | 61326 | 61357 | 61388 | 61419 | 61450 | 61481 | s |
| 36 | 61512 | 61543 | 61574 | 61605 | 61636 | 61667 | 61698 | 61729 | 61760 | 61791 | 61822 | 61852 | 1 \| 6 |
| 37 | 61883 | 61914 | 61945 | 61976 | 62006 | 62037 | 62068 | 62099 | 62129 | 62160 | 62191 | 62222 | 2 \| 12 |
| 38 | 62252 | 62283 | 62313 | 62344 | 62375 | 62405 | 62436 | 62466 | 62497 | 62528 | 62558 | 62589 | 3 \| 18 |
| 39 | 62619 | 62650 | 62680 | 62711 | 62741 | 62771 | 62802 | 62832 | 62863 | 62893 | 62923 | 62954 | 4 \| 24 |
| 40 | 1.62984 | 63014 | 63045 | 63075 | 63105 | 63136 | 63166 | 63196 | 63226 | 63257 | 63287 | 63317 | s |
| 41 | 63347 | 63377 | 63407 | 63438 | 63468 | 63498 | 63528 | 63558 | 63588 | 63618 | 63648 | 63678 | 1 \| 6 |
| 42 | 63708 | 63738 | 63768 | 63798 | 63828 | 63858 | 63888 | 63918 | 63948 | 63978 | 64008 | 64038 | 2 \| 12 |
| 43 | 64068 | 64097 | 64127 | 64157 | 64187 | 64217 | 64246 | 64276 | 64306 | 64336 | 64365 | 64395 | 3 \| 18 |
| 44 | 64425 | 64455 | 64484 | 64514 | 64544 | 64573 | 64603 | 64632 | 64662 | 64692 | 64721 | 64751 | 4 \| 24 |
| 45 | 1.64780 | 64810 | 64839 | 64869 | 64898 | 64928 | 64957 | 64987 | 65016 | 65045 | 65075 | 65105 | s |
| 46 | 65134 | 65163 | 65193 | 65222 | 65251 | 65281 | 65310 | 65339 | 65369 | 65398 | 65427 | 65456 | 1 \| 6 |
| 47 | 65486 | 65515 | 65544 | 65573 | 65603 | 65632 | 65661 | 65690 | 65719 | 65748 | 65777 | 65806 | 2 \| 12 |
| 48 | 65836 | 65865 | 65894 | 65923 | 65952 | 65981 | 66010 | 66039 | 66068 | 66097 | 66126 | 66155 | 3 \| 17 |
| 49 | 66184 | 66213 | 66242 | 66270 | 66299 | 66328 | 66357 | 66386 | 66415 | 66444 | 66472 | 66501 | 4 \| 23 |
| 50 | 1.66530 | 66559 | 66588 | 66616 | 66645 | 66674 | 66702 | 66731 | 66760 | 66789 | 66817 | 66846 | s |
| 51 | 66875 | 66903 | 66932 | 66960 | 66989 | 67018 | 67046 | 67075 | 67103 | 67132 | 67160 | 67189 | 1 \| 6 |
| 52 | 67217 | 67246 | 67274 | 67303 | 67331 | 67360 | 67388 | 67416 | 67445 | 67473 | 67502 | 67530 | 2 \| 12 |
| 53 | 67558 | 67587 | 67615 | 67643 | 67672 | 67700 | 67728 | 67756 | 67785 | 67813 | 67841 | 67869 | 3 \| 17 |
| 54 | 67897 | 67925 | 67954 | 67982 | 68010 | 68038 | 68066 | 68094 | 68123 | 68151 | 68179 | 68207 | 4 \| 23 |
| 55 | 1.68235 | 68263 | 68291 | 68319 | 68347 | 68375 | 68403 | 68431 | 68459 | 68487 | 68515 | 68543 | s |
| 56 | 68571 | 68599 | 68627 | 68654 | 68682 | 68710 | 68738 | 68766 | 68794 | 68821 | 68849 | 68877 | 1 \| 6 |
| 57 | 68905 | 68933 | 68960 | 68988 | 69016 | 69043 | 69071 | 69099 | 69127 | 69154 | 69182 | 69210 | 2 \| 11 |
| 58 | 69237 | 69265 | 69292 | 69320 | 69348 | 69375 | 69403 | 69430 | 69458 | 69486 | 69513 | 69540 | 3 \| 17 |
| 59 | 69568 | 69595 | 69623 | 69650 | 69678 | 69705 | 69733 | 69760 | 69788 | 69815 | 69842 | 69870 | 4 \| 22 |

# TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## RISING.

### 4 Hours.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4.69897 | 69924 | 69952 | 69979 | 70006 | 70034 | 70061 | 70088 | 70115 | 70143 | 70170 | 70197 | s |
| 1 | 70224 | 70252 | 70279 | 70306 | 70333 | 70360 | 70387 | 70415 | 70442 | 70469 | 70496 | 70523 | 1 \| 5 |
| 2 | 70550 | 70577 | 70604 | 70631 | 70658 | 70685 | 70712 | 70739 | 70766 | 70793 | 70820 | 70847 | 2 \| 11 |
| 3 | 70874 | 70901 | 70928 | 70955 | 70982 | 71009 | 71036 | 71063 | 71089 | 71116 | 71143 | 71170 | 3 \| 16 |
| 4 | 71197 | 71224 | 71250 | 71277 | 71304 | 71331 | 71357 | 71384 | 71411 | 71438 | 71464 | 71491 | 4 \| 22 |
| 5 | 4.71518 | 71544 | 71571 | 71598 | 71624 | 71651 | 71678 | 71704 | 71731 | 71757 | 71784 | 71810 | s |
| 6 | 71837 | 71864 | 71890 | 71917 | 71943 | 71970 | 71996 | 72023 | 72049 | 72075 | 72102 | 72128 | 1 \| 5 |
| 7 | 72155 | 72181 | 72208 | 72234 | 72260 | 72287 | 72313 | 72339 | 72366 | 72392 | 72418 | 72445 | 2 \| 10 |
| 8 | 72471 | 72497 | 72523 | 72550 | 72576 | 72602 | 72628 | 72655 | 72681 | 72707 | 72733 | 72759 | 3 \| 16 |
| 9 | 72785 | 72812 | 72838 | 72864 | 72890 | 72916 | 72942 | 72968 | 72994 | 73020 | 73046 | 73072 | 4 \| 21 |
| 10 | 4.73099 | 73125 | 73151 | 73177 | 73203 | 73228 | 73254 | 73280 | 73306 | 73332 | 73358 | 73384 | s |
| 11 | 73410 | 73436 | 73462 | 73488 | 73514 | 73539 | 73565 | 73591 | 73617 | 73643 | 73668 | 73694 | 1 \| 5 |
| 12 | 73720 | 73746 | 73772 | 73797 | 73823 | 73849 | 73874 | 73900 | 73926 | 73951 | 73977 | 74003 | 2 \| 10 |
| 13 | 74028 | 74054 | 74080 | 74105 | 74131 | 74157 | 74182 | 74208 | 74233 | 74259 | 74284 | 74310 | 3 \| 15 |
| 14 | 74335 | 74361 | 74386 | 74412 | 74437 | 74463 | 74488 | 74514 | 74539 | 74565 | 74590 | 74616 | 4 \| 20 |
| 15 | 4.74641 | 74666 | 74692 | 74717 | 74742 | 74768 | 74793 | 74818 | 74844 | 74869 | 74894 | 74920 | s |
| 16 | 74945 | 74970 | 74995 | 75021 | 75046 | 75071 | 75096 | 75122 | 75147 | 75172 | 75197 | 75222 | 1 \| 5 |
| 17 | 75247 | 75273 | 75298 | 75323 | 75348 | 75373 | 75398 | 75423 | 75448 | 75473 | 75498 | 75523 | 2 \| 10 |
| 18 | 75549 | 75574 | 75599 | 75624 | 75649 | 75674 | 75699 | 75723 | 75748 | 75773 | 75798 | 75823 | 3 \| 15 |
| 19 | 75848 | 75873 | 75898 | 75923 | 75948 | 75973 | 75997 | 76022 | 76047 | 76072 | 76097 | 76121 | 4 \| 20 |
| 20 | 4.76146 | 76171 | 76196 | 76221 | 76245 | 76270 | 76295 | 76320 | 76344 | 76369 | 76394 | 76418 | s |
| 21 | 76443 | 76468 | 76492 | 76517 | 76542 | 76566 | 76591 | 76615 | 76640 | 76665 | 76689 | 76714 | 1 \| 5 |
| 22 | 76738 | 76763 | 76787 | 76812 | 76836 | 76861 | 76885 | 76910 | 76934 | 76959 | 76983 | 77008 | 2 \| 10 |
| 23 | 77032 | 77057 | 77081 | 77105 | 77130 | 77154 | 77179 | 77203 | 77227 | 77252 | 77276 | 77300 | 3 \| 15 |
| 24 | 77325 | 77349 | 77373 | 77398 | 77422 | 77446 | 77470 | 77495 | 77519 | 77543 | 77567 | 77592 | 4 \| 20 |
| 25 | 4.77616 | 77640 | 77664 | 77688 | 77713 | 77737 | 77761 | 77785 | 77809 | 77833 | 77857 | 77882 | s |
| 26 | 77906 | 77930 | 77954 | 77978 | 78002 | 78026 | 78050 | 78074 | 78098 | 78122 | 78146 | 78170 | 1 \| 5 |
| 27 | 78194 | 78218 | 78242 | 78266 | 78290 | 78314 | 78338 | 78361 | 78385 | 78409 | 78433 | 78457 | 2 \| 10 |
| 28 | 78481 | 78505 | 78529 | 78552 | 78576 | 78600 | 78624 | 78648 | 78671 | 78695 | 78719 | 78743 | 3 \| 14 |
| 29 | 78767 | 78790 | 78814 | 78838 | 78861 | 78885 | 78909 | 78933 | 78956 | 78980 | 79004 | 79027 | 4 \| 19 |
| | 4.79051 | 79074 | 79098 | 79122 | 79145 | 79169 | 79192 | 79216 | 79240 | 79263 | 79287 | 79310 | s |
| | 79334 | 79357 | 79381 | 79404 | 79428 | 79451 | 79475 | 79498 | 79522 | 79545 | 79568 | 79592 | 1 \| 5 |
| | 79615 | 79639 | 79662 | 79686 | 79709 | 79732 | 79756 | 79779 | 79802 | 79826 | 79849 | 79872 | 2 \| 9 |
| | 79896 | 79919 | 79942 | 79965 | 79989 | 80012 | 80035 | 80059 | 80082 | 80105 | 80128 | 80151 | 3 \| 14 |
| | 80175 | 80198 | 80221 | 80244 | 80267 | 80290 | 80314 | 80337 | 80360 | 80383 | 80406 | 80429 | 4 \| 19 |
| | 4.80452 | 80475 | 80498 | 80521 | 80545 | 80568 | 80591 | 80614 | 80637 | 80660 | 80683 | 80706 | s |
| | 80729 | 80752 | 80775 | 80797 | 80820 | 80843 | 80866 | 80889 | 80912 | 80935 | 80958 | 80981 | 1 \| 5 |
| | 81004 | 81027 | 81049 | 81072 | 81095 | 81118 | 81141 | 81163 | 81186 | 81209 | 81232 | 81255 | 2 \| 9 |
| | 81277 | 81300 | 81323 | 81346 | 81368 | 81391 | 81414 | 81437 | 81459 | 81482 | 81505 | 81527 | 3 \| 14 |
| | 81550 | 81573 | 81595 | 81618 | 81641 | 81663 | 81686 | 81708 | 81731 | 81754 | 81776 | 81799 | 4 \| 18 |
| | 4.81821 | 81844 | 81866 | 81889 | 81911 | 81934 | 81956 | 81979 | 82001 | 82024 | 82046 | 82069 | s |
| | 82091 | 82114 | 82136 | 82159 | 82181 | 82203 | 82226 | 82248 | 82271 | 82293 | 82315 | 82338 | 1 \| 4 |
| | 82360 | 82382 | 82405 | 82427 | 82449 | 82472 | 82494 | 82516 | 82538 | 82561 | 82583 | 82605 | 2 \| 9 |
| | 82628 | 82650 | 82672 | 82694 | 82716 | 82739 | 82761 | 82783 | 82805 | 82827 | 82850 | 82872 | 3 \| 13 |
| | 82894 | 82916 | 82938 | 82960 | 82982 | 83004 | 83026 | 83049 | 83071 | 83093 | 83115 | 83137 | 4 \| 18 |
| | 4.83159 | 83181 | 83203 | 83225 | 83247 | 83269 | 83291 | 83313 | 83335 | 83357 | 83379 | 83401 | s |
| | 83423 | 83445 | 83467 | 83488 | 83510 | 83532 | 83554 | 83576 | 83598 | 83620 | 83642 | 83663 | 1 \| 4 |
| | 83685 | 83707 | 83729 | 83751 | 83773 | 83794 | 83816 | 83838 | 83860 | 83881 | 83903 | 83925 | 2 \| 9 |
| | 83947 | 83968 | 83990 | 84012 | 84034 | 84055 | 84077 | 84099 | 84120 | 84142 | 84164 | 84185 | 3 \| 13 |
| | 84207 | 84229 | 84250 | 84272 | 84293 | 84315 | 84337 | 84358 | 84380 | 84401 | 84423 | 84444 | 4 \| 18 |
| | 4.84466 | 84488 | 84509 | 84531 | 84552 | 84574 | 84595 | 84617 | 84638 | 84659 | 84681 | 84702 | s |
| | 84724 | 84745 | 84767 | 84788 | 84810 | 84831 | 84852 | 84874 | 84895 | 84916 | 84938 | 84959 | 1 \| 4 |
| | 84981 | 85002 | 85023 | 85044 | 85066 | 85087 | 85108 | 85130 | 85151 | 85172 | 85194 | 85215 | 2 \| 9 |
| | 85236 | 85257 | 85278 | 85300 | 85321 | 85342 | 85363 | 85385 | 85406 | 85427 | 85448 | 85469 | 3 \| 13 |
| | 85490 | 85512 | 85533 | 85554 | 85575 | 85596 | 85617 | 85638 | 85659 | 85680 | 85701 | 85722 | 4 \| 17 |
| | 4.85744 | 85765 | 85786 | 85807 | 85828 | 85849 | 85870 | 85891 | 85912 | 85933 | 85954 | 85975 | s |
| | 85996 | 86017 | 86038 | 86058 | 86079 | 86100 | 86121 | 86142 | 86163 | 86184 | 86205 | 86226 | 1 \| 4 |
| | 86247 | 86267 | 86288 | 86309 | 86330 | 86351 | 86372 | 86392 | 86413 | 86434 | 86455 | 86475 | 2 \| 8 |
| | 86496 | 86517 | 86538 | 86559 | 86579 | 86600 | 86621 | 86641 | 86662 | 86683 | 86704 | 86724 | 3 \| 13 |
| | 86745 | 86766 | 86786 | 86807 | 86828 | 86848 | 86869 | 86889 | 86910 | 86931 | 86951 | 86972 | 4 \| 17 |

# TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## RISING.

### 5 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4.86992 | 87013 | 87034 | 87054 | 87075 | 87095 | 87116 | 87136 | 87157 | 87177 | 87198 | 87218 | s |
| 1 | 87239 | 87259 | 87280 | 87300 | 87321 | 87341 | 87362 | 87382 | 87402 | 87423 | 87443 | 87464 | 1 \| 4 |
| 2 | 87484 | 87505 | 87525 | 87545 | 87566 | 87586 | 87606 | 87627 | 87647 | 87667 | 87688 | 87708 | 2 \| 8 |
| 3 | 87728 | 87749 | 87769 | 87789 | 87809 | 87830 | 87850 | 87870 | 87890 | 87911 | 87931 | 87951 | 3 \| 12 |
| 4 | 87971 | 87992 | 88012 | 88032 | 88052 | 88072 | 88093 | 88113 | 88133 | 88153 | 88173 | 88193 | 4 \| 16 |
| 5 | 4.88213 | 88234 | 88254 | 88274 | 88294 | 88314 | 88334 | 88354 | 88374 | 88394 | 88414 | 88434 | s |
| 6 | 88454 | 88474 | 88494 | 88514 | 88534 | 88554 | 88574 | 88594 | 88614 | 88634 | 88654 | 88674 | 1 \| 4 |
| 7 | 88694 | 88714 | 88734 | 88754 | 88774 | 88794 | 88814 | 88834 | 88853 | 88873 | 88893 | 88913 | 2 \| 8 |
| 8 | 88933 | 88953 | 88973 | 88992 | 89012 | 89032 | 89052 | 89072 | 89091 | 89111 | 89131 | 89151 | 3 \| 12 |
| 9 | 89171 | 89190 | 89210 | 89230 | 89250 | 89269 | 89289 | 89309 | 89328 | 89348 | 89368 | 89388 | 4 \| 16 |
| 10 | 4.89407 | 89427 | 89447 | 89466 | 89486 | 89506 | 89525 | 89545 | 89564 | 89584 | 89604 | 89623 | s |
| 11 | 89643 | 89662 | 89682 | 89702 | 89721 | 89741 | 89760 | 89780 | 89799 | 89819 | 89838 | 89858 | 1 \| 4 |
| 12 | 89877 | 89897 | 89916 | 89936 | 89955 | 89975 | 89994 | 90014 | 90033 | 90053 | 90072 | 90091 | 2 \| 8 |
| 13 | 90111 | 90130 | 90150 | 90169 | 90188 | 90208 | 90227 | 90247 | 90266 | 90285 | 90305 | 90324 | 3 \| 12 |
| 14 | 90343 | 90363 | 90382 | 90401 | 90421 | 90440 | 90459 | 90478 | 90498 | 90517 | 90536 | 90555 | 4 \| 16 |
| 15 | 4.90575 | 90594 | 90613 | 90632 | 90652 | 90671 | 90690 | 90709 | 90728 | 90748 | 90767 | 90786 | s |
| 16 | 90805 | 90824 | 90843 | 90863 | 90882 | 90901 | 90920 | 90939 | 90958 | 90977 | 90996 | 91015 | 1 \| 4 |
| 17 | 91034 | 91054 | 91073 | 91092 | 91111 | 91130 | 91149 | 91168 | 91187 | 91206 | 91225 | 91244 | 2 \| 8 |
| 18 | 91263 | 91282 | 91301 | 91320 | 91339 | 91358 | 91377 | 91396 | 91414 | 91433 | 91452 | 91471 | 3 \| 11 |
| 19 | 91490 | 91509 | 91528 | 91547 | 91566 | 91585 | 91603 | 91622 | 91641 | 91660 | 91679 | 91698 | 4 \| 15 |
| 20 | 4.91716 | 91735 | 91754 | 91773 | 91792 | 91811 | 91829 | 91848 | 91867 | 91886 | 91904 | 91923 | s |
| 21 | 91942 | 91961 | 91979 | 91998 | 92017 | 92035 | 92054 | 92073 | 92092 | 92110 | 92129 | 92148 | 1 \| 4 |
| 22 | 92166 | 92185 | 92203 | 92222 | 92241 | 92259 | 92278 | 92297 | 92315 | 92334 | 92352 | 92371 | 2 \| 7 |
| 23 | 92390 | 92408 | 92427 | 92445 | 92464 | 92483 | 92501 | 92519 | 92538 | 92556 | 92575 | 92593 | 3 \| 11 |
| 24 | 92612 | 92630 | 92649 | 92667 | 92686 | 92704 | 92723 | 92741 | 92760 | 92778 | 92796 | 92815 | 4 \| 15 |
| 25 | 4.92833 | 92851 | 92870 | 92888 | 92907 | 92925 | 92944 | 92962 | 92980 | 92999 | 93017 | 93035 | s |
| 26 | 93054 | 93072 | 93090 | 93109 | 93127 | 93145 | 93164 | 93182 | 93200 | 93218 | 93237 | 93255 | 1 \| 4 |
| 27 | 93273 | 93291 | 93310 | 93328 | 93346 | 93364 | 93382 | 93401 | 93419 | 93437 | 93455 | 93473 | 2 \| 7 |
| 28 | 93492 | 93510 | 93528 | 93546 | 93564 | 93582 | 93600 | 93619 | 93637 | 93655 | 93673 | 93691 | 3 \| 11 |
| 29 | 93709 | 93727 | 93745 | 93763 | 93781 | 93809 | 93817 | 93836 | 93854 | 93872 | 93890 | 93908 | 4 \| 15 |
| 30 | 4.93926 | 93944 | 93962 | 93980 | 93998 | 94016 | 94034 | 94052 | 94069 | 94088 | 94105 | 94123 | s |
| 31 | 94141 | 94159 | 94177 | 94195 | 94213 | 94231 | 94249 | 94267 | 91284 | 94302 | 94320 | 94338 | 1 \| 4 |
| 32 | 94356 | 94374 | 94392 | 94410 | 94427 | 94445 | 94463 | 94481 | 94498 | 94516 | 94534 | 94552 | 2 \| 7 |
| 33 | 94570 | 94587 | 94605 | 94623 | 94641 | 94658 | 94676 | 94694 | 94711 | 94729 | 94747 | 94765 | 3 \| 11 |
| 34 | 94782 | 94800 | 94818 | 94835 | 94853 | 94871 | 94888 | 94906 | 94924 | 94941 | 94959 | 94976 | 4 \| 14 |
| 35 | 4.94994 | 95012 | 95029 | 95047 | 95065 | 95082 | 95100 | 95117 | 95135 | 95153 | 95170 | 95188 | s |
| 36 | 95205 | 95223 | 95240 | 95258 | 95275 | 95293 | 95310 | 95328 | 95345 | 95363 | 95380 | 95398 | 1 \| 3 |
| 37 | 95415 | 95433 | 95450 | 95468 | 95485 | 95502 | 95520 | 95537 | 95555 | 95572 | 95589 | 95607 | 2 \| 7 |
| 38 | 95624 | 95642 | 95659 | 95676 | 95694 | 95711 | 95728 | 95746 | 95763 | 95780 | 95798 | 95815 | 3 \| 10 |
| 39 | 95832 | 95850 | 95867 | 95884 | 95902 | 95919 | 95936 | 95953 | 95971 | 95988 | 96005 | 96022 | 4 \| 14 |
| 40 | 4.96040 | 96057 | 96074 | 96091 | 96109 | 96126 | 96143 | 96160 | 96177 | 96195 | 96212 | 96229 | s |
| 41 | 96246 | 96263 | 96280 | 96297 | 96315 | 96332 | 96349 | 96366 | 96383 | 96400 | 96417 | 96434 | 1 \| 3 |
| 42 | 96451 | 96469 | 96486 | 96503 | 96520 | 96537 | 96554 | 96571 | 96588 | 96605 | 96622 | 96639 | 2 \| 7 |
| 43 | 96656 | 96673 | 96690 | 96707 | 96724 | 96741 | 96758 | 96775 | 96792 | 96809 | 96826 | 96843 | 3 \| 10 |
| 44 | 96860 | 96877 | 96894 | 96910 | 96927 | 96944 | 96961 | 96978 | 96995 | 97012 | 97029 | 97046 | 4 \| 14 |
| 45 | 4.97062 | 97079 | 97096 | 97113 | 97130 | 97147 | 97163 | 97180 | 97197 | 97214 | 97231 | 97247 | s |
| 46 | 97264 | 97281 | 97298 | 97315 | 97331 | 97348 | 97365 | 97382 | 97398 | 97415 | 97432 | 97449 | 1 \| 3 |
| 47 | 97465 | 97482 | 97499 | 97515 | 97532 | 97549 | 97565 | 97582 | 97599 | 97615 | 97632 | 97649 | 2 \| 7 |
| 48 | 97665 | 97682 | 97699 | 97715 | 97732 | 97749 | 97765 | 97782 | 97798 | 97815 | 97832 | 97848 | 3 \| 10 |
| 49 | 97865 | 97881 | 97898 | 97914 | 97931 | 97947 | 97964 | 97981 | 97997 | 98014 | 98030 | 98047 | 4 \| 13 |
| 50 | 4.98063 | 98080 | 98096 | 98113 | 98129 | 98145 | 98162 | 98178 | 98195 | 98211 | 98228 | 98244 | s |
| 51 | 98261 | 98277 | 98293 | 98310 | 98326 | 98343 | 98359 | 98375 | 98392 | 98408 | 98425 | 98441 | 1 \| 3 |
| 52 | 98457 | 98474 | 98490 | 98506 | 98523 | 98539 | 98555 | 98572 | 98588 | 98604 | 98620 | 98637 | 2 \| 7 |
| 53 | 98653 | 98669 | 98686 | 98702 | 98718 | 98734 | 98751 | 98767 | 98783 | 98799 | 98816 | 98832 | 3 \| 10 |
| 54 | 98848 | 98864 | 98880 | 98897 | 98913 | 98929 | 98945 | 98961 | 98977 | 98994 | 99010 | 99026 | 4 \| 13 |
| 55 | 4.99042 | 99058 | 99074 | 99090 | 99107 | 99123 | 99139 | 99155 | 99171 | 99187 | 99203 | 99219 | s |
| 56 | 99235 | 99251 | 99267 | 99284 | 99300 | 99316 | 99332 | 99348 | 99364 | 99380 | 99396 | 99312 | 1 \| 3 |
| 57 | 99428 | 99444 | 99460 | 99476 | 99492 | 99508 | 99524 | 99540 | 99556 | 99572 | 99587 | 99603 | 2 \| 6 |
| 58 | 99619 | 99635 | 99651 | 99667 | 99683 | 99699 | 99715 | 99731 | 99747 | 99763 | 99778 | 99794 | 3 \| 10 |
| 59 | 99810 | 99826 | 99842 | 99858 | 99873 | 99889 | 99905 | 99921 | 99937 | 99953 | 99968 | 99984 | 4 \| 13 |

# TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## RISING.

### 6 Hours.

| M | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.00000 | 00016 | 00032 | 00047 | 00063 | 00079 | 00095 | 00110 | 00126 | 00142 | 00158 | 00173 | s |
| 1 | 00189 | 00205 | 00221 | 00236 | 00252 | 00268 | 00283 | 00299 | 00315 | 00330 | 00346 | 00362 | 1 \| 3 |
| 2 | 00377 | 00393 | 00409 | 00424 | 00440 | 00456 | 00471 | 00487 | 00502 | 00518 | 00534 | 00549 | 2 \| 6 |
| 3 | 00565 | 00580 | 00596 | 00612 | 00627 | 00643 | 00658 | 00674 | 00689 | 00705 | 00720 | 00736 | 3 \| 9 |
| 4 | 00751 | 00767 | 00782 | 00798 | 00813 | 00829 | 00844 | 00860 | 00875 | 00891 | 00906 | 00922 | 4 \| 12 |
| 5 | 5.00937 | 00953 | 00968 | 00984 | 00999 | 01014 | 01030 | 01045 | 01061 | 01076 | 01091 | 01107 | s |
| 6 | 01122 | 01138 | 01153 | 01168 | 01184 | 01199 | 01214 | 01230 | 01245 | 01260 | 01276 | 01291 | 1 \| 3 |
| 7 | 01306 | 01322 | 01337 | 01352 | 01368 | 01383 | 01398 | 01413 | 01429 | 01444 | 01459 | 01474 | 2 \| 6 |
| 8 | 01490 | 01505 | 01520 | 01536 | 01551 | 01566 | 01581 | 01596 | 01612 | 01627 | 01642 | 01657 | 3 \| 9 |
| 9 | 01672 | 01688 | 01703 | 01718 | 01733 | 01748 | 01763 | 01779 | 01794 | 01809 | 01824 | 01839 | 4 \| 12 |
| 10 | 5.01854 | 01869 | 01884 | 01900 | 01915 | 01930 | 01945 | 01960 | 01975 | 01990 | 02005 | 02020 | s |
| 11 | 02035 | 02050 | 02065 | 02080 | 02095 | 02110 | 02125 | 02140 | 02155 | 02170 | 02185 | 02200 | 1 \| 3 |
| 12 | 02215 | 02230 | 02245 | 02260 | 02275 | 02290 | 02305 | 02320 | 02335 | 02350 | 02365 | 02380 | 2 \| 6 |
| 13 | 02395 | 02410 | 02425 | 02440 | 02455 | 02469 | 02484 | 02499 | 02514 | 02529 | 02544 | 02559 | 3 \| 9 |
| 14 | 02574 | 02588 | 02603 | 02618 | 02633 | 02648 | 02663 | 02677 | 02692 | 02707 | 02722 | 02737 | 4 \| 12 |
| 15 | 5.02751 | 02766 | 02781 | 02796 | 02811 | 02825 | 02840 | 02855 | 02870 | 02884 | 02899 | 02914 | s |
| 16 | 02928 | 02943 | 02958 | 02973 | 02987 | 03002 | 03017 | 03031 | 03046 | 03061 | 03075 | 03090 | 1 \| 3 |
| 17 | 03105 | 03119 | 03134 | 03149 | 03163 | 03178 | 03193 | 03207 | 03222 | 03237 | 03251 | 03266 | 2 \| 6 |
| 18 | 03280 | 03295 | 03310 | 03324 | 03339 | 03353 | 03368 | 03382 | 03397 | 03412 | 03426 | 03441 | 3 \| 9 |
| 19 | 03455 | 03470 | 03484 | 03499 | 03513 | 03528 | 03542 | 03557 | 03571 | 03586 | 03600 | 03615 | 4 \| 12 |
| 20 | 5.03629 | 03644 | 03658 | 03672 | 03687 | 03701 | 03716 | 03730 | 03745 | 03759 | 03774 | 03788 | s |
| 21 | 03802 | 03817 | 03831 | 03846 | 03860 | 03874 | 03889 | 03903 | 03918 | 03932 | 03946 | 03961 | 1 \| 3 |
| 22 | 03975 | 03989 | 04004 | 04018 | 04032 | 04047 | 04061 | 04075 | 04090 | 04104 | 04118 | 04132 | 2 \| 6 |
| 23 | 04147 | 04161 | 04175 | 04190 | 04204 | 04218 | 04232 | 04247 | 04261 | 04275 | 04289 | 04303 | 3 \| 9 |
| 24 | 04318 | 04332 | 04346 | 04360 | 04375 | 04389 | 04403 | 04417 | 04431 | 04445 | 04460 | 04474 | 4 \| 12 |
| 25 | 5.04488 | 04502 | 04516 | 04530 | 04545 | 04559 | 04573 | 04587 | 04601 | 04615 | 04629 | 04643 | s |
| 26 | 04657 | 04672 | 04686 | 04700 | 04714 | 04728 | 04742 | 04756 | 04770 | 04784 | 04798 | 04812 | 1 \| 3 |
| 27 | 04826 | 04840 | 04854 | 04868 | 04882 | 04896 | 04910 | 04924 | 04938 | 04952 | 04966 | 04980 | 2 \| 5 |
| 28 | 04994 | 05008 | 05022 | 05036 | 05050 | 05064 | 05078 | 05092 | 05106 | 05120 | 05134 | 05148 | 3 \| 8 |
| 29 | 05162 | 05175 | 05189 | 05203 | 05217 | 05231 | 05245 | 05259 | 05273 | 05286 | 05300 | 05314 | 4 \| 11 |
| 30 | 5.05328 | 05342 | 05356 | 05370 | 05383 | 05397 | 05411 | 05425 | 05439 | 05452 | 05466 | 05480 | s |
| 31 | 05494 | 05508 | 05521 | 05535 | 05549 | 05563 | 05577 | 05590 | 05604 | 05618 | 05632 | 05645 | 1 \| 3 |
| 32 | 05659 | 05673 | 05686 | 05700 | 05714 | 05728 | 05741 | 05755 | 05769 | 05782 | 05796 | 05810 | 2 \| 5 |
| 33 | 05823 | 05837 | 05851 | 05864 | 05878 | 05892 | 05905 | 05919 | 05933 | 05946 | 05960 | 05973 | 3 \| 8 |
| 34 | 05987 | 06001 | 06014 | 06028 | 06041 | 06055 | 06069 | 06082 | 06096 | 06109 | 06123 | 06136 | 4 \| 10 |
| 35 | 5.06150 | 06163 | 06177 | 06191 | 06204 | 06218 | 06231 | 06245 | 06258 | 06272 | 06285 | 06299 | s |
| 36 | 06312 | 06326 | 06339 | 06353 | 06366 | 06379 | 06393 | 06406 | 06420 | 06433 | 06447 | 06460 | 1 \| 3 |
| 37 | 06474 | 06487 | 06500 | 06514 | 06527 | 06541 | 06554 | 06567 | 06581 | 06594 | 06608 | 06621 | 2 \| 5 |
| 38 | 06634 | 06648 | 06661 | 06674 | 06688 | 06701 | 06714 | 06728 | 06741 | 06754 | 06768 | 06781 | 3 \| 8 |
| 39 | 06794 | 06808 | 06821 | 06834 | 06848 | 06861 | 06874 | 06887 | 06901 | 06914 | 06927 | 06941 | 4 \| 10 |
| 40 | 5.06954 | 06967 | 06980 | 06994 | 07007 | 07020 | 07033 | 07046 | 07060 | 07073 | 07086 | 07099 | s |
| 41 | 07112 | 07126 | 07139 | 07152 | 07165 | 07178 | 07192 | 07205 | 07218 | 07231 | 07244 | 07257 | 1 \| 3 |
| 42 | 07270 | 07284 | 07297 | 07310 | 07323 | 07336 | 07349 | 07362 | 07375 | 07388 | 07401 | 07415 | 2 \| 5 |
| 43 | 07428 | 07441 | 07454 | 07467 | 07480 | 07493 | 07506 | 07519 | 07532 | 07545 | 07558 | 07571 | 3 \| 8 |
| 44 | 07584 | 07597 | 07610 | 07623 | 07636 | 07649 | 07662 | 07675 | 07688 | 07701 | 07714 | 07727 | 4 \| 10 |
| 45 | 5.07740 | 07753 | 07766 | 07779 | 07792 | 07805 | 07818 | 07831 | 07844 | 07857 | 07869 | 07882 | s |
| 46 | 07895 | 07908 | 07921 | 07934 | 07947 | 07960 | 07973 | 07985 | 07998 | 08011 | 08024 | 08037 | 1 \| 3 |
| 47 | 08050 | 08063 | 08075 | 08088 | 08101 | 08114 | 08127 | 08140 | 08152 | 08165 | 08178 | 08191 | 2 \| 5 |
| 48 | 08204 | 08216 | 08229 | 08242 | 08255 | 08267 | 08280 | 08293 | 08306 | 08318 | 08331 | 08344 | 3 \| 8 |
| 49 | 08357 | 08369 | 08382 | 08395 | 08408 | 08420 | 08433 | 08446 | 08458 | 08471 | 08484 | 08496 | 4 \| 10 |
| 50 | 5.08509 | 08522 | 08534 | 08547 | 08560 | 08572 | 08585 | 08598 | 08610 | 08623 | 08636 | 08648 | s |
| 51 | 08661 | 08673 | 08686 | 08699 | 08711 | 08724 | 08736 | 08749 | 08762 | 08774 | 08787 | 08799 | 1 \| 2 |
| 52 | 08812 | 08824 | 08837 | 08850 | 08862 | 08875 | 08887 | 08900 | 08912 | 08925 | 08937 | 08950 | 2 \| 5 |
| 53 | 08962 | 08975 | 08987 | 09000 | 09012 | 09025 | 09037 | 09050 | 09062 | 09075 | 09087 | 09100 | 3 \| 7 |
| 54 | 09112 | 09124 | 09137 | 09149 | 09162 | 09174 | 09187 | 09199 | 09211 | 09224 | 09236 | 09249 | 4 \| 10 |
| 55 | 5.09261 | 09273 | 09286 | 09298 | 09311 | 09323 | 09335 | 09348 | 09360 | 09372 | 09385 | 09397 | s |
| 56 | 09109 | 09422 | 09434 | 09446 | 09459 | 09471 | 09483 | 09496 | 09508 | 09520 | 09533 | 09545 | 1 \| 2 |
| 57 | 09557 | 09569 | 09582 | 09594 | 09606 | 09618 | 09631 | 09643 | 09655 | 09667 | 09680 | 09692 | 2 \| 5 |
| 58 | 09704 | 09716 | 09729 | 09741 | 09753 | 09765 | 09777 | 09790 | 09802 | 09814 | 09826 | 09838 | 3 \| 7 |
| 59 | 09851 | 09863 | 09875 | 09887 | 09899 | 09911 | 09924 | 09936 | 09948 | 09960 | 09972 | 09984 | 4 \| 10 |

# TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

## RISING.

### 7 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.09996 | 10008 | 10021 | 10033 | 10045 | 10057 | 10069 | 10081 | 10093 | 10105 | 10117 | 10129 | s |
| 1 | 10141 | 10153 | 10166 | 10178 | 10190 | 10202 | 10214 | 10226 | 10238 | 10250 | 10262 | 10274 | 1 \| 2 |
| 2 | 10286 | 10298 | 10310 | 10322 | 10334 | 10346 | 10358 | 10370 | 10382 | 10394 | 10406 | 10418 | 2 \| 5 |
| 3 | 10430 | 10441 | 10454 | 10465 | 10477 | 10489 | 10501 | 10513 | 10525 | 10537 | 10549 | 10561 | 3 \| 7 |
| 4 | 10573 | 10585 | 10597 | 10608 | 10620 | 10632 | 10644 | 10656 | 10668 | 10680 | 10691 | 10703 | 4 \| 9 |
| 5 | 5.10715 | 10727 | 10739 | 10751 | 10763 | 10774 | 10786 | 10798 | 10810 | 10822 | 10833 | 10845 | s |
| 6 | 10857 | 10869 | 10881 | 10893 | 10904 | 10916 | 10928 | 10940 | 10951 | 10963 | 10975 | 10986 | 1 \| 2 |
| 7 | 10998 | 11010 | 11022 | 11033 | 11045 | 11057 | 11069 | 11080 | 11092 | 11104 | 11115 | 11127 | 2 \| 5 |
| 8 | 11139 | 11150 | 11162 | 11174 | 11185 | 11197 | 11209 | 11220 | 11232 | 11244 | 11255 | 11267 | 3 \| 7 |
| 9 | 11279 | 11290 | 11302 | 11314 | 11325 | 11337 | 11348 | 11360 | 11372 | 11383 | 11395 | 11406 | 4 \| 9 |
| 10 | 5.11418 | 11429 | 11441 | 11453 | 11464 | 11476 | 11487 | 11499 | 11510 | 11522 | 11533 | 11545 | s |
| 11 | 11557 | 11568 | 11580 | 11591 | 11603 | 11614 | 11626 | 11637 | 11649 | 11660 | 11672 | 11683 | 1 \| 2 |
| 12 | 11695 | 11706 | 11717 | 11729 | 11740 | 11752 | 11763 | 11775 | 11786 | 11798 | 11809 | 11820 | 2 \| 5 |
| 13 | 11832 | 11843 | 11855 | 11866 | 11878 | 11889 | 11900 | 11912 | 11923 | 11934 | 11946 | 11957 | 3 \| 7 |
| 14 | 11969 | 11980 | 11991 | 12003 | 12014 | 12025 | 12037 | 12048 | 12059 | 12071 | 12082 | 12093 | 4 \| 9 |
| 15 | 5.12105 | 12116 | 12127 | 12139 | 12150 | 12161 | 12173 | 12184 | 12195 | 12206 | 12218 | 12229 | s |
| 16 | 12240 | 12251 | 12263 | 12274 | 12285 | 12296 | 12308 | 12319 | 12330 | 12341 | 12353 | 12364 | 1 \| 2 |
| 17 | 12375 | 12386 | 12397 | 12409 | 12420 | 12431 | 12442 | 12453 | 12465 | 12476 | 12487 | 12498 | 2 \| 4 |
| 18 | 12509 | 12520 | 12532 | 12543 | 12554 | 12565 | 12576 | 12587 | 12598 | 12610 | 12621 | 12632 | 3 \| 7 |
| 19 | 12643 | 12654 | 12665 | 12676 | 12687 | 12698 | 12709 | 12721 | 12732 | 12743 | 12754 | 12765 | 4 \| 9 |
| 20 | 5.12776 | 12787 | 12798 | 12809 | 12820 | 12831 | 12842 | 12853 | 12864 | 12875 | 12886 | 12897 | s |
| 21 | 12908 | 12919 | 12930 | 12941 | 12952 | 12963 | 12974 | 12985 | 12996 | 13007 | 13018 | 13029 | 1 \| 2 |
| 22 | 13040 | 13051 | 13062 | 13073 | 13084 | 13095 | 13106 | 13117 | 13128 | 13139 | 13149 | 13160 | 2 \| 4 |
| 23 | 13171 | 13182 | 13193 | 13204 | 13215 | 13226 | 13237 | 13248 | 13258 | 13269 | 13280 | 13291 | 3 \| 7 |
| 24 | 13302 | 13313 | 13323 | 13334 | 13345 | 13356 | 13367 | 13378 | 13388 | 13399 | 13410 | 13421 | 4 \| 9 |
| 25 | 5.13432 | 13442 | 13453 | 13464 | 13475 | 13486 | 13496 | 13507 | 13518 | 13529 | 13539 | 13550 | s |
| 26 | 13561 | 13572 | 13582 | 13593 | 13604 | 13615 | 13625 | 13636 | 13647 | 13658 | 13668 | 13679 | 1 \| 2 |
| 27 | 13690 | 13700 | 13711 | 13722 | 13732 | 13743 | 13754 | 13765 | 13775 | 13786 | 13797 | 13807 | 2 \| 4 |
| 28 | 13818 | 13828 | 13839 | 13850 | 13860 | 13871 | 13882 | 13892 | 13903 | 13914 | 13924 | 13935 | 3 \| 7 |
| 29 | 13945 | 13956 | 13967 | 13977 | 13988 | 13998 | 14009 | 14019 | 14030 | 14041 | 14051 | 14062 | 4 \| 9 |
| 30 | 5.14072 | 14083 | 14093 | 14104 | 14114 | 14125 | 14136 | 14146 | 14157 | 14167 | 14178 | 14188 | s |
| 31 | 14199 | 14209 | 14220 | 14230 | 14241 | 14251 | 14262 | 14272 | 14282 | 14293 | 14303 | 14314 | 1 \| 2 |
| 32 | 14324 | 14335 | 14345 | 14356 | 14366 | 14377 | 14387 | 14397 | 14408 | 14418 | 14429 | 14439 | 2 \| 4 |
| 33 | 14449 | 14460 | 14470 | 14481 | 14491 | 14501 | 14512 | 14522 | 14533 | 14543 | 14553 | 14564 | 3 \| 6 |
| 34 | 14574 | 14584 | 14595 | 14605 | 14615 | 14626 | 14636 | 14646 | 14657 | 14667 | 14677 | 14688 | 4 \| 8 |
| 35 | 5.14698 | 14708 | 14719 | 14729 | 14739 | 14750 | 14760 | 14770 | 14780 | 14790 | 14801 | 14811 | s |
| 36 | 14821 | 14832 | 14842 | 14852 | 14862 | 14872 | 14883 | 14893 | 14903 | 14913 | 14924 | 14934 | 1 \| 2 |
| 37 | 14944 | 14954 | 14964 | 14975 | 14985 | 14995 | 15005 | 15015 | 15026 | 15036 | 15046 | 15056 | 2 \| 4 |
| 38 | 15066 | 15076 | 15087 | 15097 | 15107 | 15117 | 15127 | 15137 | 15147 | 15157 | 15168 | 15178 | 3 \| 6 |
| 39 | 15188 | 15198 | 15208 | 15218 | 15228 | 15238 | 15248 | 15258 | 15269 | 15279 | 15289 | 15299 | 4 \| 8 |
| 40 | 5.15309 | 15319 | 15329 | 15339 | 15349 | 15359 | 15369 | 15379 | 15389 | 15399 | 15409 | 15419 | s |
| 41 | 15429 | 15439 | 15449 | 15459 | 15469 | 15479 | 15489 | 15499 | 15509 | 15519 | 15529 | 15539 | 1 \| 2 |
| 42 | 15549 | 15559 | 15569 | 15579 | 15589 | 15599 | 15609 | 15619 | 15629 | 15639 | 15649 | 15659 | 2 \| 4 |
| 43 | 15668 | 15678 | 15688 | 15698 | 15708 | 15718 | 15728 | 15738 | 15748 | 15758 | 15767 | 15777 | 3 \| 6 |
| 44 | 15787 | 15797 | 15807 | 15817 | 15827 | 15837 | 15846 | 15856 | 15866 | 15876 | 15886 | 15896 | 4 \| 8 |
| 45 | 5.15905 | 15915 | 15925 | 15935 | 15944 | 15954 | 15964 | 15974 | 15984 | 15993 | 16003 | 16013 | s |
| 46 | 16023 | 16033 | 16042 | 16052 | 16062 | 16072 | 16081 | 16091 | 16101 | 16111 | 16120 | 16130 | 1 \| 2 |
| 47 | 16140 | 16149 | 16159 | 16169 | 16179 | 16188 | 16198 | 16208 | 16217 | 16227 | 16237 | 16246 | 2 \| 4 |
| 48 | 16256 | 16266 | 16276 | 16285 | 16295 | 16304 | 16314 | 16324 | 16333 | 16343 | 16353 | 16362 | 3 \| 6 |
| 49 | 16372 | 16382 | 16391 | 16401 | 16410 | 16420 | 16430 | 16439 | 16449 | 16459 | 16468 | 16478 | 4 \| 8 |
| 50 | 5.16487 | 16497 | 16506 | 16516 | 16526 | 16535 | 16545 | 16554 | 16564 | 16573 | 16583 | 16592 | s |
| 51 | 16602 | 16612 | 16621 | 16631 | 16640 | 16650 | 16659 | 16669 | 16678 | 16688 | 16697 | 16707 | 1 \| 2 |
| 52 | 16716 | 16726 | 16735 | 16745 | 16754 | 16764 | 16773 | 16782 | 16792 | 16801 | 16811 | 16820 | 2 \| 4 |
| 53 | 16830 | 16839 | 16849 | 16858 | 16867 | 16877 | 16886 | 16896 | 16905 | 16915 | 16924 | 16933 | 3 \| 6 |
| 54 | 16943 | 16952 | 16961 | 16971 | 16980 | 16990 | 16999 | 17008 | 17018 | 17027 | 17036 | 17046 | 4 \| 8 |
| 55 | 5.17055 | 17065 | 17074 | 17083 | 17093 | 17102 | 17111 | 17121 | 17130 | 17139 | 17148 | 17158 | s |
| 56 | 17167 | 17176 | 17186 | 17195 | 17204 | 17214 | 17223 | 17232 | 17241 | 17251 | 17260 | 17269 | 1 \| 2 |
| 57 | 17278 | 17288 | 17297 | 17306 | 17315 | 17325 | 17334 | 17343 | 17352 | 17362 | 17371 | 17380 | 2 \| 4 |
| 58 | 17389 | 17398 | 17408 | 17417 | 17426 | 17435 | 17444 | 17454 | 17463 | 17472 | 17481 | 17490 | 3 \| 6 |
| 59 | 17499 | 17509 | 17518 | 17527 | 17536 | 17545 | 17554 | 17563 | 17573 | 17582 | 17591 | 17600 | 4 \| 8 |

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽ App. Alt. | Horizontal Parallax. | | | | | | | | | | | | | | | | Add for Sec. of Par. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 53′ | | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 0″ | 2″ | 4″ | 6″ | 8″ |
| ° ′ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ″ | ″ | ″ | ″ | ″ |
| 3 0 | 38 | 21 | 39 | 21 | 40 | 20 | 41 | 20 | 42 | 20 | 43 | 20 | 44 | 20 | 45 | 20 | 46 | 20 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 38 | 52 | 39 | 52 | 40 | 52 | 41 | 52 | 42 | 52 | 43 | 51 | 44 | 51 | 45 | 51 | 46 | 51 | 10 | 10 | 12 | 14 | 16 | 18 |
| 20 | 39 | 21 | 40 | 21 | 41 | 21 | 42 | 21 | 43 | 21 | 44 | 21 | 45 | 21 | 46 | 21 | 47 | 20 | 20 | 20 | 22 | 24 | 26 | 28 |
| 30 | 39 | 49 | 40 | 49 | 41 | 49 | 42 | 48 | 43 | 48 | 44 | 48 | 45 | 48 | 46 | 48 | 47 | 48 | 30 | 30 | 32 | 34 | 36 | 38 |
| 40 | 40 | 13 | 41 | 13 | 42 | 14 | 43 | 14 | 44 | 14 | 45 | 14 | 46 | 14 | 47 | 14 | 48 | 14 | 40 | 40 | 42 | 44 | 46 | 48 |
| 50 | 40 | 39 | 41 | 39 | 42 | 39 | 43 | 39 | 44 | 39 | 45 | 38 | 46 | 38 | 47 | 38 | 48 | 38 | 50 | 50 | 52 | 54 | 56 | 58 |
| 4 0 | 41 | 2 | 42 | 2 | 43 | 2 | 44 | 2 | 45 | 1 | 46 | 1 | 47 | 1 | 48 | 1 | 49 | 1 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 41 | 24 | 42 | 24 | 43 | 23 | 44 | 23 | 45 | 23 | 46 | 23 | 47 | 23 | 48 | 23 | 49 | 22 | 10 | 10 | 12 | 14 | 16 | 18 |
| 20 | 41 | 44 | 42 | 44 | 43 | 44 | 44 | 44 | 45 | 43 | 46 | 43 | 47 | 43 | 48 | 43 | 49 | 43 | 20 | 20 | 22 | 24 | 26 | 28 |
| 30 | 42 | 3 | 43 | 3 | 44 | 3 | 45 | 3 | 46 | 3 | 47 | 2 | 48 | 2 | 49 | 2 | 50 | 2 | 30 | 30 | 32 | 34 | 36 | 38 |
| 40 | 42 | 21 | 43 | 21 | 44 | 21 | 45 | 21 | 46 | 21 | 47 | 21 | 48 | 20 | 49 | 20 | 50 | 20 | 40 | 40 | 42 | 44 | 46 | 48 |
| 50 | 42 | 39 | 43 | 39 | 44 | 38 | 45 | 38 | 46 | 38 | 47 | 38 | 48 | 37 | 49 | 37 | 50 | 37 | 50 | 50 | 52 | 54 | 56 | 58 |
| 5 0 | 42 | 55 | 43 | 55 | 44 | 54 | 45 | 54 | 46 | 54 | 47 | 54 | 48 | 54 | 49 | 53 | 50 | 53 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 43 | 10 | 44 | 10 | 45 | 10 | 46 | 10 | 47 | 9 | 48 | 9 | 49 | 9 | 50 | 9 | 51 | 8 | 10 | 10 | 12 | 14 | 16 | 18 |
| 20 | 43 | 23 | 44 | 23 | 45 | 24 | 46 | 24 | 47 | 24 | 48 | 24 | 49 | 23 | 50 | 23 | 51 | 23 | 20 | 20 | 22 | 24 | 26 | 28 |
| 30 | 43 | 37 | 44 | 38 | 45 | 38 | 46 | 38 | 47 | 38 | 48 | 37 | 49 | 37 | 50 | 37 | 51 | 36 | 30 | 30 | 32 | 34 | 36 | 38 |
| 40 | 43 | 51 | 44 | 51 | 45 | 51 | 46 | 51 | 47 | 51 | 48 | 50 | 49 | 50 | 50 | 50 | 51 | 49 | 40 | 40 | 42 | 44 | 46 | 48 |
| 50 | 44 | 3 | 45 | 3 | 46 | 3 | 47 | 3 | 48 | 3 | 49 | 3 | 50 | 2 | 51 | 2 | 52 | 2 | 50 | 50 | 52 | 54 | 56 | 58 |
| 6 0 | 44 | 15 | 45 | 16 | 46 | 15 | 47 | 15 | 48 | 15 | 49 | 14 | 50 | 14 | 51 | 14 | 52 | 13 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 44 | 27 | 45 | 27 | 46 | 26 | 47 | 26 | 48 | 26 | 49 | 25 | 50 | 25 | 51 | 25 | 52 | 24 | 10 | 10 | 12 | 14 | 16 | 18 |
| 20 | 44 | 38 | 45 | 37 | 46 | 37 | 47 | 37 | 48 | 36 | 49 | 36 | 50 | 35 | 51 | 35 | 52 | 35 | 20 | 20 | 22 | 24 | 26 | 28 |
| 30 | 44 | 49 | 45 | 47 | 46 | 47 | 47 | 47 | 48 | 46 | 49 | 46 | 50 | 45 | 51 | 45 | 52 | 45 | 30 | 30 | 32 | 34 | 36 | 38 |
| 40 | 44 | 58 | 45 | 57 | 46 | 57 | 47 | 56 | 48 | 56 | 49 | 55 | 50 | 55 | 51 | 55 | 52 | 54 | 40 | 40 | 42 | 44 | 46 | 48 |
| 50 | 45 | 7 | 46 | 6 | 47 | 6 | 48 | 5 | 49 | 5 | 50 | 4 | 51 | 4 | 52 | 4 | 53 | 3 | 50 | 50 | 52 | 54 | 56 | 58 |
| 7 0 | 45 | 16 | 46 | 15 | 47 | 14 | 48 | 14 | 49 | 13 | 50 | 13 | 51 | 13 | 52 | 12 | 53 | 12 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 45 | 24 | 46 | 23 | 47 | 22 | 48 | 22 | 49 | 21 | 50 | 21 | 51 | 21 | 52 | 20 | 53 | 20 | 10 | 10 | 12 | 14 | 16 | 18 |
| 20 | 45 | 32 | 46 | 31 | 47 | 30 | 48 | 30 | 49 | 29 | 50 | 29 | 51 | 28 | 52 | 28 | 53 | 27 | 20 | 20 | 22 | 24 | 26 | 28 |
| 30 | 45 | 40 | 46 | 38 | 47 | 38 | 48 | 37 | 49 | 37 | 50 | 36 | 51 | 36 | 52 | 35 | 53 | 35 | 30 | 30 | 32 | 34 | 36 | 38 |
| 40 | 45 | 47 | 46 | 45 | 47 | 45 | 48 | 44 | 49 | 44 | 50 | 43 | 51 | 43 | 52 | 42 | 53 | 42 | 40 | 40 | 42 | 44 | 46 | 48 |
| 50 | 45 | 53 | 46 | 52 | 47 | 52 | 48 | 51 | 49 | 51 | 50 | 50 | 51 | 49 | 52 | 49 | 53 | 48 | 50 | 50 | 52 | 54 | 56 | 58 |
| 8 0 | 46 | 0 | 46 | 59 | 47 | 58 | 48 | 58 | 49 | 57 | 50 | 56 | 51 | 56 | 52 | 55 | 53 | 55 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 46 | 6 | 47 | 5 | 48 | 4 | 49 | 4 | 50 | 3 | 51 | 2 | 52 | 2 | 53 | 1 | 54 | 1 | 10 | 10 | 12 | 14 | 16 | 18 |
| 20 | 46 | 11 | 47 | 11 | 48 | 10 | 49 | 9 | 50 | 9 | 51 | 8 | 52 | 8 | 53 | 7 | 54 | 6 | 20 | 20 | 22 | 24 | 26 | 28 |
| 30 | 46 | 17 | 47 | 16 | 48 | 16 | 49 | 15 | 50 | 14 | 51 | 14 | 52 | 13 | 53 | 12 | 54 | 12 | 30 | 30 | 32 | 34 | 36 | 38 |
| 40 | 46 | 23 | 47 | 22 | 48 | 21 | 49 | 20 | 50 | 20 | 51 | 19 | 52 | 18 | 53 | 17 | 54 | 17 | 40 | 40 | 42 | 44 | 46 | 48 |
| 50 | 46 | 28 | 47 | 27 | 48 | 26 | 49 | 25 | 50 | 25 | 51 | 24 | 52 | 23 | 53 | 22 | 54 | 22 | 50 | 50 | 52 | 54 | 56 | 58 |
| 9 0 | 46 | 33 | 47 | 31 | 48 | 31 | 49 | 30 | 50 | 29 | 51 | 29 | 52 | 28 | 53 | 27 | 54 | 26 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 46 | 37 | 47 | 36 | 48 | 35 | 49 | 35 | 50 | 34 | 51 | 33 | 52 | 32 | 53 | 31 | 54 | 31 | 10 | 10 | 12 | 14 | 16 | 18 |
| 20 | 46 | 41 | 47 | 40 | 48 | 40 | 49 | 39 | 50 | 38 | 51 | 37 | 52 | 36 | 53 | 36 | 54 | 35 | 20 | 20 | 22 | 24 | 26 | 28 |
| 30 | 46 | 45 | 47 | 45 | 48 | 44 | 49 | 43 | 50 | 42 | 51 | 41 | 52 | 40 | 53 | 40 | 54 | 39 | 30 | 30 | 32 | 34 | 36 | 38 |
| 40 | 46 | 49 | 47 | 48 | 48 | 47 | 49 | 47 | 50 | 46 | 51 | 45 | 52 | 44 | 53 | 43 | 54 | 43 | 40 | 39 | 41 | 43 | 45 | 47 |
| 50 | 46 | 53 | 47 | 52 | 48 | 51 | 49 | 50 | 50 | 50 | 51 | 49 | 52 | 48 | 53 | 47 | 54 | 46 | 50 | 49 | 51 | 53 | 55 | 57 |

## ADD FOR MINUTES OF ALTITUDE.

| ☽ Alt. | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ | ☽ Alt. | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3° 0′ | 3″ | 6″ | 9″ | 13″ | 16″ | 19″ | 22″ | 25″ | 28″ | 6° 0′ | 1″ | 2″ | 3″ | 4″ | 5″ | 7″ | 8″ | 9″ | 10″ |
| 10 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 |
| 20 | 2 | 5 | 8 | 11 | 14 | 17 | 19 | 22 | 25 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 30 | 2 | 5 | 8 | 10 | 13 | 16 | 18 | 21 | 23 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 40 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 19 | 22 | 40 | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 8 |
| 50 | 2 | 5 | 7 | 9 | 11 | 14 | 16 | 18 | 21 | 50 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| 4 0 | 2 | 4 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 7 0 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 7 | 7 |
| 10 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 10 | 1 | 2 | 2 | 3 | 4 | 5 | 5 | 6 | 7 |
| 20 | 2 | 4 | 6 | 8 | 10 | 11 | 13 | 15 | 17 | 20 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 7 |
| 30 | 2 | 4 | 5 | 7 | 9 | 11 | 13 | 14 | 16 | 30 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 6 |
| 40 | 2 | 3 | 5 | 7 | 9 | 10 | 12 | 14 | 15 | 40 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 |
| 50 | 2 | 3 | 5 | 6 | 8 | 10 | 11 | 13 | 14 | 50 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 |
| 5 0 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 14 | 8 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | 5 |
| 10 | 2 | 3 | 4 | 6 | 7 | 9 | 10 | 12 | 13 | 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 3 | 4 | 5 | 7 | 8 | 10 | 11 | 12 | 40 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 |
| 30 | 1 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 12 | 9 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 | 4 |
| 40 | 1 | 2 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | 20 | 0 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 4 |
| 50 | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 9 | 11 | 40 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 |

# TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 3 0 | 0 44 | 0 46 | 0 49 | 0 51 | 0 53 | 0 55 | 0 57 | 1 0 | 1 2 |
| 10 | 0 49 | 0 51 | 0 54 | 0 57 | 0 59 | 1 1 | 1 3 | 1 6 | 1 8 |
| 20 | 0 54 | 0 57 | 1 0 | 1 2 | 1 4 | 1 6 | 1 9 | 1 12 | 1 14 |
| 30 | 0 59 | 1 2 | 1 5 | 1 8 | 1 10 | 1 12 | 1 15 | 1 18 | 1 20 |
| 40 | 1 5 | 1 7 | 1 10 | 1 13 | 1 15 | 1 18 | 1 20 | 1 23 | 1 26 |
| 50 | 1 10 | 1 13 | 1 16 | 1 19 | 1 21 | 1 23 | 1 26 | 1 29 | 1 32 |
| 4 0 | 1 15 | 1 18 | 1 21 | 1 24 | 1 26 | 1 29 | 1 32 | 1 35 | 1 38 |
| 10 | 1 20 | 1 23 | 1 26 | 1 29 | 1 32 | 1 35 | 1 38 | 1 41 | 1 44 |
| 20 | 1 26 | 1 29 | 1 32 | 1 35 | 1 38 | 1 41 | 1 44 | 1 47 | 1 50 |
| 30 | 1 31 | 1 34 | 1 37 | 1 40 | 1 43 | 1 47 | 1 50 | 1 53 | 1 56 |
| 40 | 1 36 | 1 39 | 1 42 | 1 46 | 1 49 | 1 52 | 1 55 | 1 59 | 2 2 |
| 50 | 1 41 | 1 45 | 1 48 | 1 51 | 1 54 | 1 58 | 2 1 | 2 5 | 2 8 |
| 5 0 | 1 46 | 1 50 | 1 53 | 1 57 | 2 0 | 2 4 | 2 7 | 2 11 | 2 14 |
| 10 | 1 52 | 1 55 | 1 59 | 2 3 | 2 6 | 2 10 | 2 13 | 2 17 | 2 20 |
| 20 | 1 57 | 2 1 | 2 4 | 2 8 | 2 12 | 2 16 | 2 19 | 2 23 | 2 26 |
| 30 | 2 2 | 2 6 | 2 10 | 2 14 | 2 18 | 2 22 | 2 25 | 2 29 | 2 33 |
| 40 | 2 7 | 2 11 | 2 15 | 2 19 | 2 23 | 2 27 | 2 31 | 2 35 | 2 39 |
| 50 | 2 13 | 2 17 | 2 21 | 2 25 | 2 28 | 2 32 | 2 36 | 2 41 | 2 45 |
| 6 0 | 2 18 | 2 22 | 2 26 | 2 30 | 2 34 | 2 38 | 2 42 | 2 47 | 2 51 |
| 10 | 2 24 | 2 28 | 2 32 | 2 36 | 2 40 | 2 44 | 2 48 | 2 53 | 2 57 |
| 20 | 2 29 | 2 33 | 2 37 | 2 41 | 2 46 | 2 50 | 2 54 | 2 59 | 3 3 |
| 30 | 2 34 | 2 39 | 2 43 | 2 47 | 2 52 | 2 56 | 3 0 | 3 5 | 3 9 |
| 40 | 2 39 | 2 44 | 2 48 | 2 53 | 2 57 | 3 2 | 3 6 | 3 11 | 3 15 |
| 50 | 2 45 | 2 50 | 2 54 | 2 58 | 3 3 | 3 8 | 3 12 | 3 17 | 3 21 |
| 7 0 | 2 50 | 2 55 | 2 59 | 3 4 | 3 9 | 3 14 | 3 18 | 3 23 | 3 28 |
| 10 | 2 55 | 3 0 | 3 5 | 3 10 | 3 15 | 3 20 | 3 24 | 3 29 | 3 34 |
| 20 | 3 1 | 3 6 | 3 10 | 3 15 | 3 20 | 3 25 | 3 30 | 3 35 | 3 40 |
| 30 | 3 6 | 3 11 | 3 16 | 3 21 | 3 26 | 3 31 | 3 36 | 3 41 | 3 46 |
| 40 | 3 11 | 3 16 | 3 21 | 3 26 | 3 32 | 3 37 | 3 42 | 3 47 | 3 52 |
| 50 | 3 16 | 3 22 | 3 27 | 3 32 | 3 37 | 3 42 | 3 48 | 3 53 | 3 58 |
| 8 0 | 3 22 | 3 27 | 3 32 | 3 37 | 3 43 | 3 48 | 3 54 | 3 59 | 4 4 |
| 10 | 3 27 | 3 33 | 3 38 | 3 43 | 3 49 | 3 54 | 4 0 | 4 5 | 4 10 |
| 20 | 3 32 | 3 38 | 3 43 | 3 48 | 3 54 | 4 0 | 4 6 | 4 11 | 4 16 |
| 30 | 3 37 | 3 43 | 3 49 | 3 54 | 4 0 | 4 6 | 4 12 | 4 17 | 4 23 |
| 40 | 3 43 | 3 48 | 3 54 | 4 0 | 4 6 | 4 11 | 4 17 | 4 23 | 4 29 |
| 50 | 3 48 | 3 54 | 4 0 | 4 5 | 4 11 | 4 17 | 4 23 | 4 29 | 4 35 |
| 9 0 | 3 53 | 3 59 | 4 5 | 4 11 | 4 17 | 4 23 | 4 29 | 4 35 | 4 41 |
| 10 | 3 59 | 4 4 | 4 11 | 4 17 | 4 23 | 4 29 | 4 35 | 4 41 | 4 47 |
| 20 | 4 4 | 4 10 | 4 16 | 4 22 | 4 28 | 4 34 | 4 41 | 4 47 | 4 53 |
| 30 | 4 9 | 4 15 | 4 22 | 4 28 | 4 34 | 4 40 | 4 47 | 4 53 | 4 59 |
| 40 | 4 14 | 4 20 | 4 27 | 4 33 | 4 40 | 4 46 | 4 52 | 4 58 | 5 5 |
| 50 | 4 20 | 4 26 | 4 33 | 4 39 | 4 45 | 4 51 | 4 58 | 5 4 | 5 11 |

| Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|
| ″ | ″ | ″ | ″ | ″ |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 2 | 2 |
| 2 | 2 | 2 | 2 | 2 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 |
| 1 | 2 | 2 | 2 | 2 |
| 2 | 2 | 3 | 3 | 3 |
| 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |
| 1 | 2 | 2 | 2 | 2 |
| 2 | 2 | 2 | 3 | 3 |
| 2 | 3 | 3 | 4 | 4 |
| 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |
| 1 | 2 | 2 | 2 | 2 |
| 2 | 2 | 3 | 3 | 3 |
| 2 | 3 | 3 | 4 | 4 |
| 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 2 |
| 1 | 2 | 2 | 2 | 2 |
| 2 | 2 | 3 | 3 | 3 |
| 2 | 3 | 4 | 4 | 4 |
| 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 2 | 2 |
| 1 | 2 | 2 | 2 | 3 |
| 2 | 3 | 3 | 3 | 4 |
| 2 | 3 | 4 | 4 | 5 |

Add for Alt. of SUN.

| ° | ″ |
|---|---|
| 0 | 0 |
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 80 | 5 |
| 90 | 5 |

Add for Alt. of STAR.

| ° | ″ |
|---|---|
| 0 | 0 |
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 1 |
| 10 | 1 |
| 20 | 0 |
| 30 | 0 |
| 40 | 0 |
| 50 | 0 |
| 60 | 0 |
| 70 | 0 |
| 80 | 0 |
| 90 | 0 |

## ADD FOR MINUTES OF ALTITUDE.

| ☽ Alt. | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |
|---|---|---|---|---|---|---|---|---|---|
| 3° 0′ | 1″ | 1″ | 2″ | 2″ | 3″ | 3″ | 4″ | 4″ | 5″ |
| 10 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 30 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 50 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 4 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 10 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 30 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 50 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 5 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 10 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 30 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 50 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |

| ☽ Alt. | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |
|---|---|---|---|---|---|---|---|---|---|
| 6° 0′ | 1″ | 1″ | 2″ | 2″ | 3″ | 3″ | 4″ | 4″ | 5″ |
| 10 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 30 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 50 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 7 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 10 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 30 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 50 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 8 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 9 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 20 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ | Add for Minutes of Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ″ | ″ | ″ | ″ | ′ ″ |
| 10 0 | 46 57 | 47 56 | 48 55 | 49 54 | 50 53 | 51 52 | 52 51 | 53 50 | 54 49 | 0 | 0 2 | 4 | 6 | 8 | 0 0 |
| 10 | 47 0 | 47 59 | 48 58 | 49 57 | 50 56 | 51 55 | 52 54 | 53 53 | 54 52 | 10 | 10 12 | 14 | 16 | 18 | 1 0 |
| 20 | 47 3 | 48 2 | 49 1 | 50 0 | 50 59 | 51 58 | 52 57 | 53 56 | 54 55 | 20 | 20 22 | 24 | 26 | 28 | 2 0 |
| 30 | 47 6 | 48 5 | 49 4 | 50 3 | 51 2 | 52 1 | 53 0 | 53 59 | 54 58 | 30 | 29 31 | 33 | 35 | 37 | 3 0 |
| 40 | 47 9 | 48 8 | 49 7 | 50 6 | 51 5 | 52 4 | 53 3 | 54 2 | 55 1 | 40 | 39 41 | 43 | 45 | 47 | 4 1 |
| 50 | 47 12 | 48 11 | 49 10 | 50 9 | 51 8 | 52 7 | 53 6 | 54 4 | 55 3 | 50 | 49 51 | 53 | 55 | 57 | 4 1 |
| 11 0 | 47 14 | 48 13 | 49 12 | 50 11 | 51 10 | 52 9 | 53 8 | 54 7 | 55 6 | 0 | 0 2 | 4 | 6 | 8 | 5 1 |
| 10 | 47 17 | 48 16 | 49 15 | 50 14 | 51 12 | 52 11 | 53 10 | 54 9 | 55 8 | 10 | 10 12 | 14 | 16 | 18 | 6 1 |
| 20 | 47 19 | 48 18 | 49 17 | 50 16 | 51 14 | 52 13 | 53 12 | 54 11 | 55 10 | 20 | 20 22 | 24 | 25 | 27 | 7 2 |
| 30 | 47 22 | 48 20 | 49 19 | 50 18 | 51 16 | 52 15 | 53 14 | 54 13 | 55 12 | 30 | 29 31 | 33 | 35 | 37 | 8 2 |
| 40 | 47 23 | 48 22 | 49 21 | 50 20 | 51 18 | 52 17 | 53 16 | 54 15 | 55 14 | 40 | 39 41 | 43 | 45 | 47 | 9 2 |
| 50 | 47 25 | 48 24 | 49 23 | 50 22 | 51 20 | 52 19 | 53 18 | 54 16 | 55 16 | 50 | 49 51 | 53 | 55 | 57 | |
| 12 0 | 47 27 | 48 26 | 49 25 | 50 23 | 51 22 | 52 21 | 53 19 | 54 18 | 55 17 | 0 | 0 2 | 4 | 6 | 8 | |
| 10 | 47 29 | 48 27 | 49 26 | 50 25 | 51 23 | 52 22 | 53 21 | 54 19 | 55 18 | 10 | 10 12 | 14 | 16 | 18 | ′ ″ |
| 20 | 47 31 | 48 29 | 49 28 | 50 26 | 51 25 | 52 23 | 53 22 | 54 21 | 55 19 | 20 | 20 21 | 23 | 25 | 27 | 0 0 |
| 30 | 47 32 | 48 30 | 49 29 | 50 27 | 51 26 | 52 25 | 53 23 | 54 22 | 55 20 | 30 | 29 31 | 33 | 35 | 37 | 1 0 |
| 40 | 47 34 | 48 32 | 49 30 | 50 29 | 51 27 | 52 26 | 53 24 | 54 23 | 55 21 | 40 | 39 41 | 43 | 45 | 47 | 2 0 |
| 50 | 47 35 | 48 33 | 49 31 | 50 30 | 51 28 | 52 27 | 53 25 | 54 24 | 55 22 | 50 | 49 51 | 53 | 55 | 57 | 3 0 |
| 13 0 | 47 35 | 48 34 | 49 32 | 50 31 | 51 29 | 52 28 | 53 26 | 54 25 | 55 23 | 0 | 0 2 | 4 | 6 | 8 | 4 0 |
| 10 | 47 36 | 48 35 | 49 33 | 50 32 | 51 30 | 52 28 | 53 27 | 54 25 | 55 24 | 10 | 10 12 | 14 | 16 | 18 | 5 0 |
| 20 | 47 37 | 48 36 | 49 34 | 50 32 | 51 31 | 52 29 | 53 28 | 54 26 | 55 24 | 20 | 19 21 | 23 | 25 | 27 | 6 1 |
| 30 | 47 38 | 48 36 | 49 35 | 50 33 | 51 31 | 52 30 | 53 28 | 54 26 | 55 25 | 30 | 29 31 | 33 | 35 | 37 | 7 1 |
| 40 | 47 39 | 48 37 | 49 35 | 50 34 | 51 32 | 52 30 | 53 29 | 54 27 | 55 25 | 40 | 39 41 | 43 | 45 | 47 | 8 1 |
| 50 | 47 40 | 48 38 | 49 36 | 50 34 | 51 32 | 52 31 | 53 29 | 54 27 | 55 25 | 50 | 49 51 | 53 | 54 | 56 | 9 1 |
| 14 0 | 47 40 | 48 38 | 49 36 | 50 35 | 51 33 | 52 31 | 53 29 | 54 27 | 55 26 | 0 | 0 2 | 4 | 6 | 8 | |
| 10 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 31 | 53 29 | 54 28 | 55 26 | 10 | 10 12 | 14 | 15 | 17 | ′ ″ |
| 20 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 31 | 53 30 | 54 28 | 55 26 | 20 | 19 21 | 23 | 25 | 27 | 0 0 |
| 30 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 31 | 53 30 | 54 28 | 55 26 | 30 | 29 31 | 33 | 35 | 37 | 1 0 |
| 40 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 31 | 53 30 | 54 28 | 55 26 | 40 | 39 41 | 43 | 45 | 46 | 2 0 |
| 50 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 31 | 53 29 | 54 27 | 55 25 | 50 | 48 50 | 52 | 54 | 56 | 3 0 |
| 15 0 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 31 | 53 29 | 54 27 | 55 25 | 0 | 0 2 | 4 | 6 | 8 | 4 0 |
| 10 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 31 | 53 29 | 54 27 | 55 25 | 10 | 10 12 | 14 | 15 | 17 | 5 0 |
| 20 | 47 41 | 48 39 | 49 37 | 50 35 | 51 33 | 52 30 | 53 28 | 54 26 | 55 24 | 20 | 19 21 | 23 | 25 | 27 | 6 0 |
| 30 | 47 41 | 48 39 | 49 37 | 50 34 | 51 32 | 52 30 | 53 28 | 54 26 | 55 24 | 30 | 29 31 | 33 | 35 | 37 | 7 0 |
| 40 | 47 41 | 48 39 | 49 36 | 50 34 | 51 32 | 52 30 | 53 27 | 54 25 | 55 23 | 40 | 39 40 | 42 | 44 | 46 | 8 0 |
| 50 | 47 40 | 48 38 | 49 36 | 50 34 | 51 31 | 52 29 | 53 27 | 54 24 | 55 22 | 50 | 48 50 | 52 | 54 | 56 | 9 0 |
| 16 0 | 47 30 | 48 28 | 49 25 | 50 23 | 51 21 | 52 18 | 53 16 | 54 14 | 55 11 | 0 | 0 2 | 4 | 6 | 8 | |
| 10 | 47 30 | 48 27 | 49 25 | 50 22 | 51 20 | 52 18 | 53 15 | 54 13 | 55 10 | 10 | 10 11 | 13 | 15 | 17 | ′ ″ |
| 20 | 47 29 | 48 27 | 49 24 | 50 22 | 51 19 | 52 17 | 53 15 | 54 12 | 55 9 | 20 | 19 21 | 23 | 25 | 27 | 0 10 |
| 30 | 47 29 | 48 26 | 49 23 | 50 21 | 51 19 | 52 16 | 53 14 | 54 11 | 55 8 | 30 | 29 31 | 33 | 35 | 37 | 1 10 |
| 40 | 47 29 | 48 25 | 49 23 | 50 20 | 51 18 | 52 15 | 53 13 | 54 10 | 55 7 | 40 | 38 40 | 42 | 44 | 46 | 2 10 |
| 50 | 47 28 | 48 24 | 49 22 | 50 19 | 51 17 | 52 14 | 53 12 | 54 9 | 55 6 | 50 | 48 50 | 52 | 54 | 56 | 3 10 |
| 17 0 | 47 27 | 48 24 | 49 21 | 50 18 | 51 16 | 52 13 | 53 11 | 54 8 | 55 5 | 0 | 0 2 | 4 | 6 | 8 | 4 10 |
| 10 | 47 25 | 48 23 | 49 20 | 50 17 | 51 15 | 52 12 | 53 9 | 54 7 | 55 4 | 10 | 10 11 | 13 | 15 | 17 | 5 9 |
| 20 | 47 24 | 48 22 | 49 19 | 50 16 | 51 14 | 52 11 | 53 8 | 54 5 | 55 3 | 20 | 19 21 | 23 | 25 | 27 | 6 9 |
| 30 | 47 24 | 48 21 | 49 18 | 50 15 | 51 12 | 52 10 | 53 7 | 54 4 | 55 1 | 30 | 29 30 | 32 | 34 | 36 | 7 9 |
| 40 | 47 23 | 48 20 | 49 17 | 50 14 | 51 11 | 52 8 | 53 6 | 54 3 | 55 0 | 40 | 38 40 | 42 | 44 | 46 | 8 9 |
| 50 | 47 22 | 48 19 | 49 16 | 50 13 | 51 10 | 52 7 | 53 4 | 54 1 | 54 58 | 50 | 48 50 | 52 | 53 | 55 | 9 9 |
| 18 0 | 47 20 | 48 17 | 49 14 | 50 12 | 51 9 | 52 6 | 53 3 | 54 0 | 54 57 | 0 | 0 2 | 4 | 6 | 8 | |
| 10 | 47 20 | 48 16 | 49 13 | 50 10 | 51 7 | 52 4 | 53 1 | 53 58 | 54 55 | 10 | 9 11 | 13 | 15 | 17 | ′ ″ |
| 20 | 47 18 | 48 15 | 49 12 | 50 9 | 51 6 | 52 3 | 53 0 | 53 57 | 54 54 | 20 | 19 21 | 23 | 25 | 27 | 0 10 |
| 30 | 47 16 | 48 13 | 49 10 | 50 7 | 51 4 | 52 1 | 52 58 | 53 55 | 54 52 | 30 | 28 30 | 32 | 34 | 36 | 1 10 |
| 40 | 47 15 | 48 12 | 49 9 | 50 6 | 51 3 | 51 59 | 52 56 | 53 53 | 54 50 | 40 | 38 40 | 42 | 44 | 46 | 2 10 |
| 50 | 47 14 | 48 11 | 49 7 | 50 4 | 51 1 | 51 58 | 52 55 | 53 51 | 54 48 | 50 | 47 49 | 51 | 53 | 55 | 3 10 |
| 19 0 | 47 13 | 48 9 | 49 6 | 50 3 | 50 59 | 51 56 | 52 53 | 53 50 | 54 46 | 0 | 0 2 | 4 | 6 | 8 | 4 9 |
| 10 | 47 11 | 48 8 | 49 4 | 50 1 | 50 58 | 51 54 | 52 51 | 53 48 | 54 44 | 10 | 9 11 | 13 | 15 | 17 | 5 9 |
| 20 | 47 10 | 48 6 | 49 3 | 49 59 | 50 56 | 51 52 | 52 49 | 53 46 | 54 42 | 20 | 19 21 | 23 | 25 | 27 | 6 9 |
| 30 | 47 8 | 48 4 | 49 1 | 49 57 | 50 54 | 51 51 | 52 47 | 53 44 | 54 40 | 30 | 28 30 | 32 | 34 | 36 | 7 9 |
| 40 | 47 6 | 48 3 | 48 59 | 49 56 | 50 52 | 51 49 | 52 45 | 53 42 | 54 38 | 40 | 38 40 | 42 | 44 | 46 | 8 9 |
| 50 | 47 4 | 48 1 | 48 57 | 49 54 | 50 50 | 51 47 | 52 43 | 53 39 | 54 36 | 50 | 47 49 | 51 | 53 | 55 | 9 9 |

# TABLE XXX.*

**Auxiliary Arcs.**—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 10 0 | 4 25 | 4 31 | 4 38 | 4 44 | 4 51 | 4 57 | 5 4 | 5 10 | 5 17 |
| 10 | 4 30 | 4 37 | 4 44 | 4 50 | 4 57 | 5 3 | 5 10 | 5 16 | 5 23 |
| 20 | 4 35 | 4 42 | 4 49 | 4 55 | 5 2 | 5 9 | 5 16 | 5 22 | 5 29 |
| 30 | 4 41 | 4 47 | 4 54 | 5 1 | 5 8 | 5 15 | 5 22 | 5 28 | 5 35 |
| 40 | 4 46 | 4 53 | 5 0 | 5 7 | 5 14 | 5 20 | 5 27 | 5 34 | 5 41 |
| 50 | 4 51 | 4 58 | 5 5 | 5 12 | 5 19 | 5 26 | 5 33 | 5 40 | 5 47 |
| 11 0 | 4 56 | 5 3 | 5 11 | 5 18 | 5 25 | 5 32 | 5 39 | 5 46 | 5 53 |
| 10 | 5 2 | 5 9 | 5 16 | 5 24 | 5 31 | 5 38 | 5 45 | 5 52 | 5 59 |
| 20 | 5 7 | 5 14 | 5 22 | 5 29 | 5 36 | 5 43 | 5 51 | 5 58 | 6 5 |
| 30 | 5 12 | 5 19 | 5 27 | 5 35 | 5 42 | 5 49 | 5 57 | 6 4 | 6 11 |
| 40 | 5 17 | 5 24 | 5 32 | 5 40 | 5 47 | 5 55 | 6 2 | 6 10 | 6 17 |
| 50 | 5 23 | 5 30 | 5 38 | 5 46 | 5 53 | 6 0 | 6 8 | 6 16 | 6 23 |
| 12 0 | 5 28 | 5 35 | 5 43 | 5 51 | 5 58 | 6 6 | 6 14 | 6 22 | 6 29 |
| 10 | 5 33 | 5 40 | 5 48 | 5 56 | 6 4 | 6 12 | 6 20 | 6 28 | 6 35 |
| 20 | 5 38 | 5 46 | 5 54 | 6 2 | 6 10 | 6 18 | 6 26 | 6 34 | 6 41 |
| 30 | 5 43 | 5 51 | 5 59 | 6 7 | 6 15 | 6 23 | 6 31 | 6 39 | 6 47 |
| 40 | 5 49 | 5 57 | 6 5 | 6 13 | 6 21 | 6 29 | 6 37 | 6 45 | 6 53 |
| 50 | 5 54 | 6 2 | 6 10 | 6 18 | 6 27 | 6 35 | 6 43 | 6 51 | 6 59 |
| 13 0 | 5 59 | 6 7 | 6 15 | 6 24 | 6 32 | 6 40 | 6 49 | 6 57 | 7 5 |
| 10 | 6 4 | 6 12 | 6 21 | 6 30 | 6 38 | 6 46 | 6 55 | 7 3 | 7 11 |
| 20 | 6 9 | 6 18 | 6 26 | 6 35 | 6 43 | 6 51 | 7 0 | 7 9 | 7 17 |
| 30 | 6 15 | 6 23 | 6 32 | 6 41 | 6 49 | 6 57 | 7 6 | 7 15 | 7 23 |
| 40 | 6 20 | 6 28 | 6 37 | 6 46 | 6 55 | 7 3 | 7 12 | 7 20 | 7 29 |
| 50 | 6 25 | 6 34 | 6 43 | 6 52 | 7 0 | 7 8 | 7 17 | 7 26 | 7 35 |
| 14 0 | 6 30 | 6 39 | 6 48 | 6 57 | 7 6 | 7 14 | 7 23 | 7 32 | 7 41 |
| 10 | 6 35 | 6 44 | 6 53 | 7 2 | 7 11 | 7 20 | 7 29 | 7 38 | 7 47 |
| 20 | 6 41 | 6 50 | 6 59 | 7 8 | 7 17 | 7 26 | 7 35 | 7 44 | 7 53 |
| 30 | 6 46 | 6 55 | 7 4 | 7 13 | 7 22 | 7 31 | 7 41 | 7 50 | 7 59 |
| 40 | 6 51 | 7 0 | 7 9 | 7 18 | 7 28 | 7 37 | 7 46 | 7 55 | 8 5 |
| 50 | 6 56 | 7 6 | 7 15 | 7 24 | 7 33 | 7 42 | 7 52 | 8 1 | 8 11 |
| 15 0 | 7 1 | 7 11 | 7 20 | 7 29 | 7 39 | 7 48 | 7 58 | 8 7 | 8 17 |
| 10 | 7 6 | 7 16 | 7 25 | 7 35 | 7 45 | 7 54 | 8 4 | 8 13 | 8 23 |
| 20 | 7 11 | 7 21 | 7 31 | 7 40 | 7 50 | 7 59 | 8 9 | 8 19 | 8 29 |
| 30 | 7 17 | 7 27 | 7 36 | 7 46 | 7 56 | 8 5 | 8 15 | 8 25 | 8 35 |
| 40 | 7 22 | 7 32 | 7 41 | 7 51 | 8 1 | 8 11 | 8 21 | 8 30 | 8 40 |
| 50 | 7 27 | 7 37 | 7 47 | 7 57 | 8 7 | 8 16 | 8 26 | 8 36 | 8 46 |
| 16 0 | 7 32 | 7 42 | 7 52 | 8 2 | 8 12 | 8 22 | 8 32 | 8 42 | 8 52 |
| 10 | 7 37 | 7 47 | 7 57 | 8 7 | 8 18 | 8 28 | 8 38 | 8 48 | 8 58 |
| 20 | 7 42 | 7 52 | 8 3 | 8 13 | 8 23 | 8 33 | 8 43 | 8 54 | 9 4 |
| 30 | 7 47 | 7 58 | 8 8 | 8 18 | 8 29 | 8 39 | 8 49 | 9 0 | 9 10 |
| 40 | 7 52 | 8 3 | 8 13 | 8 23 | 8 34 | 8 45 | 8 55 | 9 5 | 9 15 |
| 50 | 7 57 | 8 8 | 8 19 | 8 29 | 8 40 | 8 50 | 9 0 | 9 11 | 9 21 |
| 17 0 | 8 2 | 8 13 | 8 24 | 8 34 | 8 45 | 8 56 | 9 6 | 9 17 | 9 27 |
| 10 | 8 8 | 8 18 | 8 29 | 8 40 | 8 51 | 9 2 | 9 12 | 9 23 | 9 33 |
| 20 | 8 13 | 8 23 | 8 34 | 8 45 | 8 56 | 9 7 | 9 17 | 9 28 | 9 39 |
| 30 | 8 18 | 8 29 | 8 39 | 8 50 | 9 1 | 9 12 | 9 23 | 9 34 | 9 45 |
| 40 | 8 23 | 8 34 | 8 45 | 8 56 | 9 7 | 9 18 | 9 29 | 9 40 | 9 51 |
| 50 | 8 28 | 8 39 | 8 50 | 9 1 | 9 12 | 9 23 | 9 35 | 9 46 | 9 57 |
| 18 0 | 8 33 | 8 44 | 8 55 | 9 6 | 9 18 | 9 29 | 9 40 | 9 51 | 10 2 |
| 10 | 8 38 | 8 49 | 9 0 | 9 11 | 9 23 | 9 35 | 9 46 | 9 57 | 10 8 |
| 20 | 8 43 | 8 54 | 9 6 | 9 17 | 9 29 | 9 40 | 9 51 | 10 2 | 10 14 |
| 30 | 8 48 | 9 0 | 9 11 | 9 22 | 9 34 | 9 46 | 9 57 | 10 8 | 10 20 |
| 40 | 8 53 | 9 5 | 9 16 | 9 27 | 9 39 | 9 51 | 10 3 | 10 14 | 10 25 |
| 50 | 8 58 | 9 10 | 9 22 | 9 33 | 9 45 | 9 57 | 10 8 | 10 19 | 10 31 |
| 19 0 | 9 3 | 9 15 | 9 27 | 9 38 | 9 50 | 10 2 | 10 14 | 10 25 | 10 37 |
| 10 | 9 8 | 9 20 | 9 32 | 9 44 | 9 56 | 10 8 | 10 20 | 10 31 | 10 43 |
| 20 | 9 13 | 9 25 | 9 37 | 9 49 | 10 1 | 10 13 | 10 25 | 10 37 | 10 49 |
| 30 | 9 18 | 9 30 | 9 42 | 9 54 | 10 6 | 10 19 | 10 31 | 10 43 | 10 55 |
| 40 | 9 23 | 9 36 | 9 48 | 10 0 | 10 12 | 10 24 | 10 36 | 10 48 | 11 0 |
| 50 | 9 28 | 9 41 | 9 53 | 10 5 | 10 17 | 10 30 | 10 42 | 10 54 | 11 6 |

| Add for Sec. of Par | | | | | |
|---|---|---|---|---|---|
| | 0″ | 2″ | 4″ | 6″ | 8″ |
| ″ | ′ | ″ | ″ | ″ | ″ |
| 0 | 0 | 0 | 0 | 1 | 1 |
| 10 | 1 | 1 | 2 | 2 | 2 |
| 20 | 2 | 2 | 3 | 3 | 3 |
| 30 | 3 | 4 | 4 | 4 | 4 |
| 40 | 4 | 5 | 5 | 5 | 5 |
| 50 | 6 | 6 | 6 | 6 | 6 |

Add for Alt. of Sun.

| ° | ′ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 80 | 5 |
| 90 | 5 |

Add for Alt. of Star.

| ° | ′ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 1 |
| 10 | 1 |
| 20 | 0 |
| 30 | 0 |
| 40 | 0 |
| 50 | 0 |
| 60 | 0 |
| 70 | 0 |
| 80 | 0 |
| 90 | 0 |

| Add for Minutes of Moon's Alt. | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |
|---|---|---|---|---|---|---|---|---|---|
| | 1″ | 1″ | 2″ | 2″ | 3″ | 3″ | 4″ | 4″ | 5″ |

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ | Add for Minutes of Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ″ | ″ | ″ | ″ | ′ ″ |
| 20 0 | 47 3 | 47 59 | 48 55 | 49 52 | 50 48 | 51 45 | 52 41 | 53 37 | 54 34 | 0 | 0 | 2 | 4 | 6 | 8 |
| 10 | 47 1 | 47 57 | 48 53 | 49 50 | 50 46 | 51 42 | 52 39 | 53 35 | 54 31 | 10 | 9 | 11 | 13 | 15 | 17 |
| 20 | 47 0 | 47 55 | 48 51 | 49 48 | 50 44 | 51 40 | 52 36 | 53 33 | 54 29 | 20 | 19 | 21 | 22 | 24 | 26 |
| 30 | 46 58 | 47 53 | 48 49 | 49 46 | 50 42 | 51 38 | 52 34 | 53 30 | 54 27 | 30 | 28 | 30 | 32 | 34 | 36 |
| 40 | 46 56 | 47 51 | 48 47 | 49 43 | 50 40 | 51 36 | 52 32 | 53 28 | 54 24 | 40 | 37 | 39 | 41 | 43 | 45 |
| 50 | 46 54 | 47 49 | 48 45 | 49 41 | 50 37 | 51 34 | 52 30 | 53 26 | 54 22 | 50 | 47 | 49 | 51 | 52 | 54 |
| 21 0 | 46 52 | 47 47 | 48 43 | 49 39 | 50 35 | 51 31 | 52 27 | 53 23 | 54 19 | 0 | 0 | 2 | 4 | 6 | 7 |
| 10 | 46 50 | 47 45 | 48 41 | 49 37 | 50 33 | 51 29 | 52 25 | 53 21 | 54 17 | 10 | 9 | 11 | 13 | 15 | 17 |
| 20 | 46 47 | 47 43 | 48 39 | 49 35 | 50 30 | 51 26 | 52 22 | 53 18 | 54 14 | 20 | 19 | 21 | 22 | 24 | 26 |
| 30 | 46 45 | 47 41 | 48 36 | 49 32 | 50 28 | 51 24 | 52 20 | 53 16 | 54 11 | 30 | 28 | 30 | 31 | 33 | 35 |
| 40 | 46 43 | 47 38 | 48 34 | 49 30 | 50 26 | 51 21 | 52 17 | 53 13 | 54 9 | 40 | 37 | 39 | 41 | 43 | 45 |
| 50 | 46 41 | 47 36 | 48 32 | 49 27 | 50 23 | 51 19 | 52 15 | 53 10 | 54 6 | 50 | 47 | 48 | 50 | 52 | 54 |
| 22 0 | 46 39 | 47 34 | 48 29 | 49 25 | 50 21 | 51 16 | 52 12 | 53 8 | 54 3 | 0 | 0 | 2 | 4 | 6 | 7 |
| 10 | 46 36 | 47 31 | 48 27 | 49 22 | 50 18 | 51 14 | 52 9 | 53 5 | 54 0 | 10 | 9 | 11 | 13 | 15 | 17 |
| 20 | 46 33 | 47 29 | 48 24 | 49 20 | 50 15 | 51 11 | 52 6 | 53 2 | 53 57 | 20 | 18 | 20 | 22 | 24 | 26 |
| 30 | 46 31 | 47 26 | 48 22 | 49 17 | 50 13 | 51 8 | 52 4 | 52 59 | 53 54 | 30 | 28 | 30 | 31 | 33 | 35 |
| 40 | 46 29 | 47 24 | 48 19 | 49 15 | 50 10 | 51 5 | 52 1 | 52 56 | 53 51 | 40 | 37 | 39 | 41 | 43 | 44 |
| 50 | 46 26 | 47 21 | 48 17 | 49 12 | 50 7 | 51 3 | 51 58 | 52 53 | 53 48 | 50 | 46 | 48 | 50 | 52 | 54 |
| 23 0 | 46 23 | 47 19 | 48 14 | 49 9 | 50 4 | 51 0 | 51 55 | 52 50 | 53 45 | 0 | 0 | 2 | 4 | 6 | 7 |
| 10 | 46 20 | 47 16 | 48 11 | 49 6 | 50 2 | 50 57 | 51 52 | 52 47 | 53 42 | 10 | 9 | 11 | 13 | 15 | 17 |
| 20 | 46 17 | 47 13 | 48 9 | 49 4 | 49 59 | 50 54 | 51 49 | 52 44 | 53 39 | 20 | 18 | 20 | 22 | 24 | 26 |
| 30 | 46 15 | 47 11 | 48 6 | 49 1 | 49 56 | 50 51 | 51 46 | 52 41 | 53 36 | 30 | 28 | 29 | 31 | 33 | 35 |
| 40 | 46 12 | 47 8 | 48 3 | 48 58 | 49 53 | 50 48 | 51 43 | 52 38 | 53 33 | 40 | 37 | 39 | 40 | 42 | 44 |
| 50 | 46 10 | 47 5 | 48 0 | 48 55 | 49 50 | 50 45 | 51 40 | 52 34 | 53 29 | 50 | 46 | 48 | 50 | 51 | 53 |
| 24 0 | 46 7 | 47 2 | 47 57 | 48 52 | 49 47 | 50 42 | 51 37 | 52 31 | 53 26 | 0 | 0 | 2 | 4 | 5 | 7 |
| 10 | 46 4 | 47 0 | 47 54 | 48 49 | 49 44 | 50 38 | 51 33 | 52 28 | 53 23 | 10 | 9 | 11 | 13 | 15 | 16 |
| 20 | 46 1 | 46 57 | 47 51 | 48 46 | 49 41 | 50 35 | 51 30 | 52 25 | 53 19 | 20 | 18 | 20 | 22 | 24 | 25 |
| 30 | 45 58 | 46 54 | 47 48 | 48 43 | 49 37 | 50 32 | 51 27 | 52 21 | 53 16 | 30 | 27 | 29 | 31 | 33 | 35 |
| 40 | 45 55 | 46 51 | 47 45 | 48 40 | 49 34 | 50 29 | 51 23 | 52 18 | 53 12 | 40 | 36 | 38 | 40 | 42 | 44 |
| 50 | 45 53 | 46 48 | 47 42 | 48 37 | 49 31 | 50 25 | 51 20 | 52 14 | 53 9 | 50 | 46 | 47 | 49 | 51 | 53 |
| 25 0 | 45 50 | 46 45 | 47 39 | 48 33 | 49 28 | 50 22 | 51 17 | 52 11 | 53 5 | 0 | 0 | 2 | 4 | 5 | 7 |
| 10 | 45 47 | 46 42 | 47 36 | 48 30 | 49 24 | 50 19 | 51 13 | 52 7 | 53 2 | 10 | 9 | 11 | 12 | 14 | 16 |
| 20 | 45 44 | 46 38 | 47 33 | 48 27 | 49 21 | 50 15 | 51 10 | 52 4 | 52 58 | 20 | 18 | 20 | 22 | 23 | 25 |
| 30 | 45 41 | 46 35 | 47 29 | 48 24 | 49 18 | 50 12 | 51 6 | 52 0 | 52 54 | 30 | 27 | 29 | 31 | 32 | 34 |
| 40 | 45 38 | 46 32 | 47 26 | 48 20 | 49 14 | 50 8 | 51 3 | 51 57 | 52 51 | 40 | 36 | 38 | 40 | 41 | 43 |
| 50 | 45 35 | 46 29 | 47 23 | 48 17 | 49 11 | 50 5 | 50 59 | 51 53 | 52 47 | 50 | 45 | 47 | 49 | 51 | 52 |
| 26 0 | 45 32 | 46 26 | 47 20 | 48 13 | 49 7 | 50 1 | 50 55 | 51 49 | 52 43 | 0 | 0 | 2 | 4 | 5 | 7 |
| 10 | 45 29 | 46 22 | 47 16 | 48 10 | 49 4 | 49 58 | 50 52 | 51 45 | 52 39 | 10 | 9 | 11 | 13 | 14 | 16 |
| 20 | 45 25 | 46 19 | 47 13 | 48 7 | 49 0 | 49 54 | 50 48 | 51 42 | 52 35 | 20 | 18 | 20 | 21 | 23 | 25 |
| 30 | 45 22 | 46 16 | 47 9 | 48 3 | 48 57 | 49 50 | 50 44 | 51 38 | 52 31 | 30 | 27 | 29 | 30 | 32 | 34 |
| 40 | 45 19 | 46 12 | 47 6 | 47 59 | 48 53 | 49 47 | 50 40 | 51 34 | 52 28 | 40 | 36 | 38 | 40 | 41 | 43 |
| 50 | 45 16 | 46 9 | 47 2 | 47 56 | 48 49 | 49 43 | 50 36 | 51 30 | 52 24 | 50 | 45 | 47 | 48 | 50 | 52 |
| 27 0 | 45 12 | 46 5 | 46 59 | 47 52 | 48 46 | 49 39 | 50 33 | 51 26 | 52 20 | 0 | 0 | 2 | 4 | 5 | 7 |
| 10 | 45 9 | 46 2 | 46 55 | 47 49 | 48 42 | 49 35 | 50 29 | 51 22 | 52 16 | 10 | 9 | 11 | 12 | 14 | 16 |
| 20 | 45 5 | 45 58 | 46 52 | 47 45 | 48 38 | 49 32 | 50 25 | 51 18 | 52 11 | 20 | 18 | 20 | 21 | 23 | 25 |
| 30 | 45 2 | 45 55 | 46 48 | 47 41 | 48 34 | 49 28 | 50 21 | 51 14 | 52 7 | 30 | 27 | 28 | 30 | 32 | 34 |
| 40 | 44 58 | 45 51 | 46 44 | 47 37 | 48 30 | 49 24 | 50 17 | 51 10 | 52 3 | 40 | 35 | 37 | 39 | 41 | 43 |
| 50 | 44 54 | 45 48 | 46 41 | 47 34 | 48 27 | 49 20 | 50 13 | 51 6 | 51 59 | 50 | 44 | 46 | 48 | 50 | 51 |
| 28 0 | 44 51 | 45 44 | 46 37 | 47 30 | 48 23 | 49 16 | 50 9 | 51 2 | 51 55 | 0 | 0 | 2 | 4 | 5 | 7 |
| 10 | 44 47 | 45 40 | 46 33 | 47 26 | 48 19 | 49 12 | 50 5 | 50 58 | 51 50 | 10 | 9 | 11 | 12 | 14 | 16 |
| 20 | 44 43 | 45 36 | 46 29 | 47 22 | 48 15 | 49 8 | 50 0 | 50 54 | 51 46 | 20 | 18 | 19 | 21 | 23 | 25 |
| 30 | 44 40 | 45 33 | 46 25 | 47 18 | 48 11 | 49 4 | 49 56 | 50 49 | 51 42 | 30 | 27 | 28 | 30 | 32 | 33 |
| 40 | 44 36 | 45 29 | 46 22 | 47 14 | 48 7 | 48 59 | 49 52 | 50 45 | 51 37 | 40 | 35 | 37 | 39 | 40 | 42 |
| 50 | 44 32 | 45 25 | 46 18 | 47 10 | 48 3 | 48 55 | 49 48 | 50 40 | 51 33 | 50 | 44 | 46 | 47 | 49 | 51 |
| 29 0 | 44 29 | 45 21 | 46 14 | 47 6 | 47 59 | 48 51 | 49 44 | 50 36 | 51 29 | 0 | 0 | 2 | 3 | 5 | 7 |
| 10 | 44 25 | 45 17 | 46 10 | 47 2 | 47 55 | 48 47 | 49 39 | 50 32 | 51 24 | 10 | 9 | 10 | 12 | 14 | 16 |
| 20 | 44 21 | 45 13 | 46 6 | 46 58 | 47 50 | 48 43 | 49 35 | 50 27 | 51 20 | 20 | 17 | 19 | 21 | 23 | 24 |
| 30 | 44 18 | 45 9 | 46 2 | 46 54 | 47 46 | 48 38 | 49 31 | 50 23 | 51 15 | 30 | 26 | 28 | 30 | 31 | 33 |
| 40 | 44 14 | 45 5 | 45 58 | 46 50 | 47 42 | 48 34 | 49 26 | 50 18 | 51 10 | 40 | 35 | 37 | 38 | 40 | 42 |
| 50 | 44 10 | 45 1 | 45 54 | 46 46 | 47 38 | 48 30 | 49 22 | 50 14 | 51 6 | 50 | 44 | 45 | 47 | 49 | 50 |

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# TABLE XXX.*

**Auxiliary Arcs.**—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 20 0 | 9 33 | 9 46 | 9 58 | 10 10 | 10 22 | 10 35 | 10 47 | 10 59 | 11 12 |
| 10 | 9 38 | 9 51 | 10 3 | 10 16 | 10 28 | 10 40 | 10 53 | 11 5 | 11 18 |
| 20 | 9 43 | 9 56 | 10 8 | 10 21 | 10 33 | 10 46 | 10 58 | 11 11 | 11 23 |
| 30 | 9 48 | 10 1 | 10 14 | 10 26 | 10 39 | 10 51 | 11 4 | 11 16 | 11 29 |
| 40 | 9 53 | 10 6 | 10 19 | 10 31 | 10 44 | 10 57 | 11 10 | 11 22 | 11 35 |
| 50 | 9 58 | 10 11 | 10 24 | 10 37 | 10 49 | 11 2 | 11 15 | 11 28 | 11 41 |
| 21 0 | 10 3 | 10 16 | 10 29 | 10 42 | 10 55 | 11 8 | 11 20 | 11 33 | 11 46 |
| 10 | 10 8 | 10 21 | 10 34 | 10 47 | 11 0 | 11 13 | 11 26 | 11 39 | 11 52 |
| 20 | 10 13 | 10 26 | 10 39 | 10 52 | 11 5 | 11 19 | 11 32 | 11 45 | 11 58 |
| 30 | 10 18 | 10 31 | 10 45 | 10 58 | 11 11 | 11 24 | 11 37 | 11 50 | 12 3 |
| 40 | 10 23 | 10 36 | 10 50 | 11 3 | 11 16 | 11 29 | 11 42 | 11 56 | 12 9 |
| 50 | 10 28 | 10 41 | 10 55 | 11 8 | 11 21 | 11 35 | 11 48 | 12 1 | 12 15 |
| 22 0 | 10 33 | 10 46 | 11 0 | 11 13 | 11 26 | 11 40 | 11 53 | 12 7 | 12 20 |
| 10 | 10 38 | 10 51 | 11 5 | 11 18 | 11 32 | 11 45 | 11 59 | 12 12 | 12 26 |
| 20 | 10 43 | 10 56 | 11 10 | 11 23 | 11 37 | 11 51 | 12 5 | 12 18 | 12 32 |
| 30 | 10 48 | 11 1 | 11 15 | 11 29 | 11 42 | 11 56 | 12 10 | 12 24 | 12 37 |
| 40 | 10 53 | 11 6 | 11 20 | 11 34 | 11 48 | 12 2 | 12 15 | 12 29 | 12 43 |
| 50 | 10 57 | 11 11 | 11 25 | 11 39 | 11 53 | 12 7 | 12 21 | 12 35 | 12 49 |
| 23 0 | 11 2 | 11 16 | 11 30 | 11 44 | 11 58 | 12 12 | 12 26 | 12 40 | 12 54 |
| 10 | 11 7 | 11 21 | 11 35 | 11 49 | 12 3 | 12 18 | 12 32 | 12 46 | 13 0 |
| 20 | 11 12 | 11 26 | 11 40 | 11 54 | 12 9 | 12 23 | 12 37 | 12 51 | 13 5 |
| 30 | 11 17 | 11 31 | 11 45 | 12 0 | 12 14 | 12 28 | 12 43 | 12 57 | 13 11 |
| 40 | 11 22 | 11 36 | 11 50 | 12 5 | 12 19 | 12 34 | 12 48 | 13 2 | 13 17 |
| 50 | 11 27 | 11 41 | 11 55 | 12 10 | 12 24 | 12 39 | 12 53 | 13 8 | 13 22 |
| 24 0 | 11 32 | 11 46 | 12 0 | 12 15 | 12 30 | 12 44 | 12 59 | 13 13 | 13 27 |
| 10 | 11 36 | 11 51 | 12 6 | 12 20 | 12 35 | 12 49 | 13 4 | 13 19 | 13 33 |
| 20 | 11 41 | 11 56 | 12 11 | 12 25 | 12 40 | 12 55 | 13 10 | 13 24 | 13 39 |
| 30 | 11 46 | 12 1 | 12 16 | 12 30 | 12 45 | 13 0 | 13 15 | 13 30 | 13 45 |
| 40 | 11 51 | 12 6 | 12 21 | 12 36 | 12 50 | 13 5 | 13 20 | 13 35 | 13 50 |
| 50 | 11 56 | 12 11 | 12 26 | 12 41 | 12 56 | 13 11 | 13 26 | 13 40 | 13 55 |
| 25 0 | 12 0 | 12 15 | 12 31 | 12 46 | 13 1 | 13 16 | 13 31 | 13 46 | 14 1 |
| 10 | 12 5 | 12 20 | 12 36 | 12 51 | 13 6 | 13 21 | 13 36 | 13 51 | 14 7 |
| 20 | 12 10 | 12 25 | 12 41 | 12 56 | 13 11 | 13 26 | 13 42 | 13 57 | 14 12 |
| 30 | 12 15 | 12 30 | 12 46 | 13 1 | 13 16 | 13 32 | 13 47 | 14 2 | 14 17 |
| 40 | 12 20 | 12 35 | 12 50 | 13 6 | 13 21 | 13 37 | 13 52 | 14 8 | 14 23 |
| 50 | 12 24 | 12 40 | 12 55 | 13 11 | 13 27 | 13 42 | 13 58 | 14 13 | 14 29 |
| 26 0 | 12 29 | 12 45 | 13 0 | 13 16 | 13 32 | 13 47 | 14 3 | 14 18 | 14 34 |
| 10 | 12 34 | 12 50 | 13 5 | 13 21 | 13 37 | 13 52 | 14 8 | 14 24 | 14 39 |
| 20 | 12 39 | 12 55 | 13 10 | 13 26 | 13 42 | 13 58 | 14 13 | 14 29 | 14 45 |
| 30 | 12 44 | 12 59 | 13 15 | 13 31 | 13 47 | 14 3 | 14 19 | 14 35 | 14 50 |
| 40 | 12 48 | 13 4 | 13 20 | 13 36 | 13 52 | 14 8 | 14 24 | 14 40 | 14 56 |
| 50 | 12 53 | 13 9 | 13 25 | 13 41 | 13 57 | 14 13 | 14 29 | 14 45 | 15 1 |
| 27 0 | 12 58 | 13 14 | 13 30 | 13 46 | 14 2 | 14 18 | 14 35 | 14 51 | 15 7 |
| 10 | 13 2 | 13 19 | 13 35 | 13 51 | 14 7 | 14 23 | 14 40 | 14 56 | 15 12 |
| 20 | 13 7 | 13 23 | 13 40 | 13 56 | 14 12 | 14 29 | 14 45 | 15 1 | 15 17 |
| 30 | 13 12 | 13 28 | 13 45 | 14 1 | 14 17 | 14 34 | 14 50 | 15 7 | 15 23 |
| 40 | 13 17 | 13 33 | 13 49 | 14 6 | 14 22 | 14 39 | 14 55 | 15 12 | 15 28 |
| 50 | 13 21 | 13 38 | 13 54 | 14 11 | 14 27 | 14 44 | 15 1 | 15 17 | 15 34 |
| 28 0 | 13 26 | 13 42 | 13 59 | 14 16 | 14 32 | 14 49 | 15 6 | 15 22 | 15 39 |
| 10 | 13 30 | 13 47 | 14 4 | 14 21 | 14 37 | 14 54 | 15 11 | 15 28 | 15 45 |
| 20 | 13 35 | 13 52 | 14 9 | 14 26 | 14 42 | 14 59 | 15 16 | 15 33 | 15 50 |
| 30 | 13 40 | 13 57 | 14 14 | 14 31 | 14 47 | 15 4 | 15 21 | 15 38 | 15 55 |
| 40 | 13 45 | 14 1 | 14 18 | 14 35 | 14 52 | 15 9 | 15 26 | 15 43 | 16 1 |
| 50 | 13 49 | 14 6 | 14 23 | 14 41 | 14 57 | 15 15 | 15 32 | 15 49 | 16 6 |
| 29 0 | 13 54 | 14 11 | 14 28 | 14 45 | 15 2 | 15 20 | 15 37 | 15 54 | 16 11 |
| 10 | 13 59 | 14 16 | 14 33 | 14 50 | 15 7 | 15 25 | 15 42 | 15 59 | 16 17 |
| 20 | 14 3 | 14 20 | 14 38 | 14 55 | 15 12 | 15 30 | 15 47 | 16 4 | 16 22 |
| 30 | 14 8 | 14 25 | 14 42 | 15 0 | 15 17 | 15 35 | 15 52 | 16 10 | 16 27 |
| 40 | 14 12 | 14 30 | 14 47 | 15 5 | 15 22 | 15 40 | 15 57 | 16 15 | 16 32 |
| 50 | 14 17 | 14 35 | 14 52 | 15 10 | 15 27 | 15 45 | 16 2 | 16 20 | 16 38 |

Add for Minutes of Moon's Alt. { 1′ 2′ 3′ 4′ 5′ 6′ 7′ 8′ 9′ / 1″ 1″ 2″ 2″ 3″ 3″ 4″ 4″ 5″

| Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|
| ″ | ″ | ″ | ″ | ″ |
| 0 | 0 | 1 | 1 | 2 |
| 0 | 0 | 1 | 1 | 2 |
| 0 | 0 | 1 | 1 | 2 

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 30 0 | 44 6 | 44 57 | 45 49 | 46 41 | 47 33 | 48 25 | 49 17 | 50 9 | 51 1 |
| 10 | 44 2 | 44 53 | 45 45 | 46 37 | 47 29 | 48 21 | 49 13 | 50 5 | 50 57 |
| 20 | 43 58 | 44 49 | 45 41 | 46 33 | 47 25 | 48 16 | 49 8 | 50 0 | 50 52 |
| 30 | 43 54 | 44 45 | 45 37 | 46 29 | 47 20 | 48 12 | 49 4 | 49 55 | 50 47 |
| 40 | 43 50 | 44 41 | 45 33 | 46 24 | 47 16 | 48 7 | 48 59 | 49 51 | 50 42 |
| 50 | 43 45 | 44 37 | 45 28 | 46 20 | 47 11 | 48 3 | 48 54 | 49 46 | 50 37 |
| 31 0 | 43 41 | 44 33 | 45 24 | 46 15 | 47 7 | 47 58 | 48 50 | 49 41 | 50 33 |
| 10 | 43 37 | 44 28 | 45 20 | 46 11 | 47 2 | 47 54 | 48 45 | 49 36 | 50 28 |
| 20 | 43 33 | 44 24 | 45 15 | 46 7 | 46 58 | 47 49 | 48 40 | 49 32 | 50 23 |
| 30 | 43 29 | 44 20 | 45 11 | 46 2 | 46 53 | 47 44 | 48 36 | 49 27 | 50 18 |
| 40 | 43 25 | 44 15 | 45 6 | 45 58 | 46 49 | 47 40 | 48 31 | 49 22 | 50 13 |
| 50 | 43 20 | 44 11 | 45 2 | 45 53 | 46 44 | 47 35 | 48 26 | 49 17 | 50 8 |
| 32 0 | 43 15 | 44 7 | 44 58 | 45 48 | 46 39 | 47 30 | 48 21 | 49 12 | 50 3 |
| 10 | 43 11 | 44 2 | 44 53 | 45 44 | 46 35 | 47 25 | 48 16 | 49 7 | 49 58 |
| 20 | 43 7 | 43 58 | 44 48 | 45 39 | 46 30 | 47 21 | 48 11 | 49 2 | 49 53 |
| 30 | 43 3 | 43 53 | 44 44 | 45 35 | 46 25 | 47 16 | 48 6 | 48 57 | 49 48 |
| 40 | 42 58 | 43 49 | 44 39 | 45 30 | 46 20 | 47 11 | 48 1 | 48 52 | 49 42 |
| 50 | 42 54 | 43 44 | 44 35 | 45 25 | 46 16 | 47 6 | 47 56 | 48 47 | 49 37 |
| 33 0 | 42 50 | 43 40 | 44 30 | 45 20 | 46 11 | 47 1 | 47 51 | 48 42 | 49 32 |
| 10 | 42 46 | 43 35 | 44 25 | 45 16 | 46 6 | 46 56 | 47 46 | 48 36 | 49 27 |
| 20 | 42 41 | 43 30 | 44 21 | 45 11 | 46 1 | 46 51 | 47 41 | 48 31 | 49 21 |
| 30 | 42 36 | 43 26 | 44 16 | 45 6 | 45 56 | 46 46 | 47 36 | 48 26 | 49 16 |
| 40 | 42 32 | 43 21 | 44 11 | 45 1 | 45 51 | 46 41 | 47 31 | 48 21 | 49 11 |
| 50 | 42 27 | 43 16 | 44 6 | 44 56 | 45 46 | 46 36 | 47 26 | 48 16 | 49 5 |
| 34 0 | 42 22 | 43 12 | 44 2 | 44 51 | 45 41 | 46 31 | 47 20 | 48 10 | 49 0 |
| 10 | 42 17 | 43 7 | 43 57 | 44 46 | 45 36 | 46 26 | 47 15 | 48 5 | 48 54 |
| 20 | 42 12 | 43 2 | 43 52 | 44 41 | 45 31 | 46 20 | 47 10 | 47 59 | 48 49 |
| 30 | 42 8 | 42 57 | 43 47 | 44 36 | 45 26 | 46 15 | 47 5 | 47 54 | 48 44 |
| 40 | 42 4 | 42 53 | 43 42 | 44 31 | 45 21 | 46 10 | 46 59 | 47 49 | 48 38 |
| 50 | 41 59 | 42 48 | 43 37 | 44 26 | 45 15 | 46 5 | 46 54 | 47 43 | 48 32 |
| 35 0 | 41 54 | 42 43 | 43 32 | 44 21 | 45 10 | 45 59 | 46 49 | 47 38 | 48 27 |
| 10 | 41 49 | 42 38 | 43 27 | 44 16 | 45 5 | 45 54 | 46 43 | 47 32 | 48 21 |
| 20 | 41 45 | 42 33 | 43 22 | 44 11 | 45 0 | 45 49 | 46 38 | 47 27 | 48 16 |
| 30 | 41 40 | 42 28 | 43 17 | 44 6 | 44 55 | 45 43 | 46 32 | 47 21 | 48 10 |
| 40 | 41 35 | 42 23 | 43 12 | 44 0 | 44 49 | 45 38 | 46 27 | 47 15 | 48 4 |
| 50 | 41 30 | 42 18 | 43 7 | 43 55 | 44 44 | 45 33 | 46 21 | 47 10 | 47 58 |
| 36 0 | 41 25 | 42 13 | 43 1 | 43 50 | 44 39 | 45 27 | 46 16 | 47 4 | 47 53 |
| 10 | 41 20 | 42 8 | 42 56 | 43 45 | 44 33 | 45 22 | 46 10 | 46 58 | 47 47 |
| 20 | 41 15 | 42 3 | 42 51 | 43 39 | 44 28 | 45 16 | 46 4 | 46 53 | 47 41 |
| 30 | 41 10 | 41 58 | 42 46 | 43 34 | 44 22 | 45 11 | 45 59 | 46 47 | 47 35 |
| 40 | 41 4 | 41 52 | 42 41 | 43 29 | 44 17 | 45 5 | 45 53 | 46 41 | 47 29 |
| 50 | 40 59 | 41 47 | 42 35 | 43 23 | 44 11 | 44 59 | 45 47 | 46 35 | 47 23 |
| 37 0 | 40 54 | 41 42 | 42 30 | 43 18 | 44 6 | 44 54 | 45 42 | 46 30 | 47 18 |
| 10 | 40 49 | 41 37 | 42 25 | 43 12 | 44 0 | 44 48 | 45 36 | 46 24 | 47 12 |
| 20 | 40 44 | 41 32 | 42 19 | 43 7 | 43 55 | 44 42 | 45 30 | 46 18 | 47 6 |
| 30 | 40 39 | 41 26 | 42 14 | 43 1 | 43 49 | 44 37 | 45 24 | 46 12 | 47 0 |
| 40 | 40 33 | 41 21 | 42 8 | 42 56 | 43 43 | 44 31 | 45 18 | 46 6 | 46 53 |
| 50 | 40 28 | 41 16 | 42 3 | 42 50 | 43 38 | 44 25 | 45 13 | 46 0 | 46 47 |
| 38 0 | 40 23 | 41 10 | 41 58 | 42 45 | 43 32 | 44 19 | 45 7 | 45 54 | 46 41 |
| 10 | 40 17 | 41 5 | 41 52 | 42 39 | 43 26 | 44 14 | 45 1 | 45 48 | 46 35 |
| 20 | 40 12 | 41 0 | 41 47 | 42 34 | 43 21 | 44 8 | 44 55 | 45 42 | 46 29 |
| 30 | 40 7 | 40 54 | 41 41 | 42 28 | 43 15 | 44 2 | 44 49 | 45 36 | 46 23 |
| 40 | 40 2 | 40 49 | 41 35 | 42 22 | 43 9 | 43 56 | 44 43 | 45 30 | 46 17 |
| 50 | 39 57 | 40 43 | 41 30 | 42 17 | 43 3 | 43 50 | 44 37 | 45 24 | 46 10 |
| 39 0 | 39 52 | 40 38 | 41 24 | 42 11 | 42 58 | 43 44 | 44 31 | 45 17 | 46 4 |
| 10 | 39 46 | 40 32 | 41 19 | 42 5 | 42 52 | 43 38 | 44 25 | 45 11 | 45 58 |
| 20 | 39 40 | 40 27 | 41 13 | 41 59 | 42 46 | 43 32 | 44 19 | 45 5 | 45 51 |
| 30 | 39 35 | 40 21 | 41 7 | 41 54 | 42 40 | 43 26 | 44 12 | 44 59 | 45 45 |
| 40 | 39 29 | 40 15 | 41 2 | 41 48 | 42 34 | 43 20 | 44 6 | 44 53 | 45 39 |
| 50 | 39 24 | 40 10 | 40 56 | 41 42 | 42 28 | 43 14 | 44 0 | 44 46 | 45 32 |

| Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|
| ″ | ″ | ″ | ″ | ″ |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 9 | 10 | 12 | 14 |
| 20 | 17 | 19 | 21 | 22 |
| 30 | 26 | 28 | 29 | 31 |
| 40 | 34 | 36 | 38 | 40 |
| 50 | 43 | 45 | 47 | 48 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 9 | 10 | 12 | 14 |
| 20 | 17 | 19 | 20 | 22 |
| 30 | 26 | 27 | 29 | 31 |
| 40 | 34 | 36 | 38 | 39 |
| 50 | 43 | 44 | 46 | 48 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 9 | 10 | 12 | 13 |
| 20 | 17 | 18 | 20 | 22 |
| 30 | 25 | 27 | 28 | 30 |
| 40 | 33 | 35 | 37 | 38 |
| 50 | 42 | 43 | 45 | 47 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 10 | 12 | 13 |
| 20 | 17 | 18 | 20 | 22 |
| 30 | 25 | 27 | 28 | 30 |
| 40 | 33 | 35 | 37 | 38 |
| 50 | 42 | 43 | 45 | 47 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 10 | 11 | 13 |
| 20 | 16 | 18 | 20 | 21 |
| 30 | 24 | 26 | 28 | 29 |
| 40 | 33 | 34 | 36 | 37 |
| 50 | 41 | 42 | 44 | 46 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 10 | 11 | 13 |
| 20 | 16 | 18 | 19 | 21 |
| 30 | 24 | 26 | 27 | 29 |
| 40 | 32 | 34 | 35 | 37 |
| 50 | 41 | 42 | 43 | 45 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 10 | 11 | 13 |
| 20 | 16 | 18 | 19 | 21 |
| 30 | 24 | 26 | 27 | 29 |
| 40 | 32 | 34 | 35 | 37 |
| 50 | 40 | 42 | 43 | 45 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 10 | 11 | 13 |
| 20 | 16 | 18 | 19 | 21 |
| 30 | 24 | 26 | 27 | 29 |
| 40 | 32 | 34 | 35 | 37 |
| 50 | 40 | 42 | 43 | 45 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 10 | 11 | 13 |
| 20 | 16 | 17 | 19 | 21 |
| 30 | 24 | 25 | 27 | 29 |
| 40 | 32 | 33 | 35 | 36 |
| 50 | 40 | 41 | 43 | 44 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 9 | 11 | 12 |
| 20 | 16 | 17 | 19 | 20 |
| 30 | 23 | 25 | 27 | 28 |
| 40 | 31 | 33 | 34 | 36 |
| 50 | 39 | 41 | 42 | 44 |
| 0 | 0 | 2 | 3 | 5 |
| 10 | 8 | 9 | 11 | 12 |
| 20 | 15 | 17 | 19 | 20 |
| 30 | 23 | 25 | 26 | 28 |
| 40 | 31 | 32 | 34 | 36 |
| 50 | 39 | 40 | 42 | 43 |

| Add for Minutes of Alt. | |
|---|---|
| ′ | ″ |
| 0 | 10 |
| 1 | 10 |
| 2 | 9 |
| 3 | 9 |
| 4 | 8 |
| 5 | 8 |
| 6 | 7 |
| 7 | 7 |
| 8 | 6 |
| 9 | 6 |
| ′ | ″ |
| 0 | 10 |
| 1 | 10 |
| 2 | 9 |
| 3 | 9 |
| 4 | 8 |
| 5 | 8 |
| 6 | 7 |
| 7 | 7 |
| 8 | 6 |
| 9 | 6 |
| ′ | ″ |
| 0 | 10 |
| 1 | 9 |
| 2 | 9 |
| 3 | 8 |
| 4 | 8 |
| 5 | 7 |
| 6 | 7 |
| 7 | 6 |
| 8 | 6 |
| 9 | 5 |
| ′ | ″ |
| 0 | 10 |
| 1 | 9 |
| 2 | 9 |
| 3 | 8 |
| 4 | 8 |
| 5 | 7 |
| 6 | 7 |
| 7 | 6 |
| 8 | 6 |
| 9 | 5 |
| ′ | ″ |
| 0 | 10 |
| 1 | 9 |
| 2 | 9 |
| 3 | 8 |
| 4 | 8 |
| 5 | 7 |
| 6 | 7 |
| 7 | 6 |
| 8 | 5 |
| 9 | 5 |

# TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 30 0 | 14 21 | 14 39 | 14 57 | 15 14 | 15 32 | 15 50 | 16 7 | 16 25 | 16 43 |
| 10 | 14 26 | 14 44 | 15 1 | 15 19 | 15 37 | 15 55 | 16 13 | 16 30 | 16 48 |
| 20 | 14 30 | 14 48 | 15 6 | 15 24 | 15 42 | 16 0 | 16 18 | 16 36 | 16 53 |
| 30 | 14 35 | 14 53 | 15 11 | 15 29 | 15 47 | 16 5 | 16 23 | 16 41 | 16 59 |
| 40 | 14 40 | 14 58 | 15 16 | 15 34 | 15 52 | 16 10 | 16 28 | 16 46 | 17 4 |
| 50 | 14 44 | 15 2 | 15 20 | 15 39 | 15 57 | 16 15 | 16 33 | 16 51 | 17 9 |
| 31 0 | 14 49 | 15 7 | 15 25 | 15 43 | 16 2 | 16 20 | 16 38 | 16 56 | 17 14 |
| 10 | 14 53 | 15 11 | 15 30 | 15 48 | 16 7 | 16 25 | 16 43 | 17 1 | 17 19 |
| 20 | 14 58 | 15 16 | 15 34 | 15 53 | 16 11 | 16 30 | 16 48 | 17 6 | 17 25 |
| 30 | 15 2 | 15 21 | 15 39 | 15 58 | 16 16 | 16 35 | 16 53 | 17 11 | 17 30 |
| 40 | 15 6 | 15 25 | 15 44 | 16 2 | 16 21 | 16 40 | 16 58 | 17 16 | 17 35 |
| 50 | 15 11 | 15 30 | 15 49 | 16 7 | 16 26 | 16 45 | 17 3 | 17 22 | 17 40 |
| 32 0 | 15 16 | 15 35 | 15 53 | 16 12 | 16 31 | 16 49 | 17 8 | 17 27 | 17 45 |
| 10 | 15 20 | 15 39 | 15 58 | 16 17 | 16 36 | 16 54 | 17 13 | 17 32 | 17 51 |
| 20 | 15 25 | 15 44 | 16 2 | 16 21 | 16 40 | 16 59 | 17 18 | 17 37 | 17 56 |
| 30 | 15 29 | 15 48 | 16 7 | 16 26 | 16 45 | 17 4 | 17 23 | 17 42 | 18 1 |
| 40 | 15 34 | 15 53 | 16 12 | 16 31 | 16 50 | 17 9 | 17 28 | 17 47 | 18 6 |
| 50 | 15 38 | 15 57 | 16 16 | 16 36 | 16 55 | 17 14 | 17 33 | 17 52 | 18 11 |
| 33 0 | 15 43 | 16 2 | 16 21 | 16 40 | 16 59 | 17 19 | 17 38 | 17 57 | 18 16 |
| 10 | 15 48 | 16 7 | 16 26 | 16 45 | 17 4 | 17 24 | 17 43 | 18 2 | 18 21 |
| 20 | 15 52 | 16 11 | 16 30 | 16 50 | 17 9 | 17 28 | 17 48 | 18 7 | 18 26 |
| 30 | 15 56 | 16 15 | 16 35 | 16 54 | 17 14 | 17 33 | 17 53 | 18 12 | 18 31 |
| 40 | 16 0 | 16 20 | 16 39 | 16 59 | 17 18 | 17 38 | 17 57 | 18 17 | 18 36 |
| 50 | 16 5 | 16 24 | 16 44 | 17 3 | 17 23 | 17 43 | 18 2 | 18 22 | 18 41 |
| 34 0 | 16 9 | 16 29 | 16 48 | 17 8 | 17 28 | 17 47 | 18 7 | 18 27 | 18 46 |
| 10 | 16 13 | 16 33 | 16 53 | 17 13 | 17 32 | 17 52 | 18 12 | 18 32 | 18 51 |
| 20 | 16 18 | 16 37 | 16 57 | 17 17 | 17 37 | 17 57 | 18 17 | 18 37 | 18 57 |
| 30 | 16 22 | 16 42 | 17 2 | 17 22 | 17 42 | 18 2 | 18 22 | 18 42 | 19 2 |
| 40 | 16 26 | 16 46 | 17 6 | 17 26 | 17 47 | 18 7 | 18 27 | 18 47 | 19 7 |
| 50 | 16 31 | 16 51 | 17 11 | 17 31 | 17 51 | 18 11 | 18 32 | 18 52 | 19 12 |
| 35 0 | 16 35 | 16 55 | 17 15 | 17 36 | 17 56 | 18 16 | 18 36 | 18 56 | 19 17 |
| 10 | 16 39 | 17 0 | 17 20 | 17 40 | 18 0 | 18 21 | 18 41 | 19 1 | 19 22 |
| 20 | 16 44 | 17 4 | 17 24 | 17 45 | 18 5 | 18 26 | 18 46 | 19 6 | 19 27 |
| 30 | 16 48 | 17 8 | 17 29 | 17 49 | 18 10 | 18 30 | 18 51 | 19 11 | 19 32 |
| 40 | 16 52 | 17 13 | 17 33 | 17 54 | 18 14 | 18 35 | 18 55 | 19 16 | 19 37 |
| 50 | 16 57 | 17 17 | 17 38 | 17 58 | 18 19 | 18 40 | 19 0 | 19 21 | 19 41 |
| 36 0 | 17 1 | 17 22 | 17 42 | 18 3 | 18 24 | 18 44 | 19 5 | 19 26 | 19 46 |
| 10 | 17 5 | 17 26 | 17 47 | 18 7 | 18 28 | 18 49 | 19 10 | 19 30 | 19 51 |
| 20 | 17 9 | 17 30 | 17 51 | 18 12 | 18 33 | 18 53 | 19 14 | 19 35 | 19 56 |
| 30 | 17 13 | 17 34 | 17 55 | 18 16 | 18 37 | 18 58 | 19 19 | 19 40 | 20 1 |
| 40 | 17 18 | 17 39 | 18 0 | 18 21 | 18 42 | 19 3 | 19 24 | 19 45 | 20 6 |
| 50 | 17 22 | 17 43 | 18 4 | 18 25 | 18 46 | 19 8 | 19 29 | 19 50 | 20 11 |
| 37 0 | 17 26 | 17 47 | 18 9 | 18 30 | 18 51 | 19 12 | 19 33 | 19 54 | 20 15 |
| 10 | 17 31 | 17 52 | 18 13 | 18 34 | 18 55 | 19 17 | 19 38 | 19 59 | 20 20 |
| 20 | 17 35 | 17 56 | 18 17 | 18 39 | 19 0 | 19 21 | 19 42 | 20 4 | 20 25 |
| 30 | 17 39 | 18 0 | 18 22 | 18 43 | 19 5 | 19 26 | 19 47 | 20 9 | 20 30 |
| 40 | 17 43 | 18 4 | 18 26 | 18 47 | 19 9 | 19 31 | 19 52 | 20 13 | 20 35 |
| 50 | 17 47 | 18 9 | 18 30 | 18 52 | 19 14 | 19 35 | 19 57 | 20 18 | 20 40 |
| 38 0 | 17 51 | 18 13 | 18 35 | 18 56 | 19 18 | 19 39 | 20 1 | 20 23 | 20 44 |
| 10 | 17 55 | 18 17 | 18 39 | 19 1 | 19 22 | 19 44 | 20 6 | 20 27 | 20 49 |
| 20 | 18 0 | 18 21 | 18 43 | 19 5 | 19 27 | 19 49 | 20 10 | 20 32 | 20 54 |
| 30 | 18 4 | 18 26 | 18 48 | 19 9 | 19 31 | 19 53 | 20 15 | 20 37 | 20 59 |
| 40 | 18 8 | 18 30 | 18 52 | 19 14 | 19 36 | 19 58 | 20 20 | 20 42 | 21 4 |
| 50 | 18 12 | 18 34 | 18 56 | 19 18 | 19 40 | 20 2 | 20 24 | 20 46 | 21 8 |
| 39 0 | 18 16 | 18 38 | 19 0 | 19 22 | 19 44 | 20 7 | 20 29 | 20 51 | 21 13 |
| 10 | 18 20 | 18 43 | 19 5 | 19 27 | 19 49 | 20 11 | 20 33 | 20 55 | 21 18 |
| 20 | 18 24 | 18 47 | 19 9 | 19 31 | 19 54 | 20 16 | 20 38 | 21 0 | 21 22 |
| 30 | 18 28 | 18 51 | 19 13 | 19 35 | 19 58 | 20 20 | 20 43 | 21 5 | 21 27 |
| 40 | 18 33 | 18 55 | 19 17 | 19 40 | 20 2 | 20 25 | 20 47 | 21 9 | 21 32 |
| 50 | 18 37 | 18 59 | 19 22 | 19 44 | 20 7 | 20 29 | 20 51 | 21 14 | 21 36 |

| Add for Sec. of Par. | 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|---|
| ″ | ″ | ″ | ″ | ″ | ″ |
| 0 | 0 | 1 | 1 | 2 | 2 |
| 10 | 3 | 4 | 4 | 5 | 5 |
| 20 | 6 | 7 | 7 | 8 | 8 |
| 30 | 9 | 10 | 10 | 11 | 11 |
| 40 | 12 | 13 | 13 | 14 | 14 |
| 50 | 15 | 16 | 16 | 17 | 17 |
| 0 | 0 | 1 | 1 | 2 | 2 |
| 10 | 3 | 4 | 4 | 5 | 6 |
| 20 | 6 | 7 | 7 | 8 | 9 |
| 30 | 9 | 10 | 10 | 11 | 12 |
| 40 | 12 | 13 | 14 | 14 | 15 |
| 50 | 15 | 16 | 17 | 17 | 18 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 3 | 4 | 5 | 5 | 6 |
| 20 | 6 | 7 | 8 | 8 | 9 |
| 30 | 10 | 10 | 11 | 12 | 12 |
| 40 | 13 | 13 | 14 | 15 | 15 |
| 50 | 16 | 16 | 17 | 18 | 18 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 3 | 4 | 5 | 5 | 6 |
| 20 | 6 | 7 | 8 | 8 | 9 |
| 30 | 10 | 10 | 11 | 12 | 12 |
| 40 | 13 | 14 | 14 | 15 | 15 |
| 50 | 16 | 17 | 17 | 18 | 19 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 3 | 4 | 5 | 5 | 6 |
| 20 | 7 | 7 | 8 | 9 | 9 |
| 30 | 10 | 11 | 11 | 12 | 13 |
| 40 | 13 | 14 | 15 | 15 | 16 |
| 50 | 17 | 18 | 18 | 19 | 20 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 3 | 4 | 5 | 5 | 6 |
| 20 | 7 | 7 | 8 | 9 | 10 |
| 30 | 10 | 11 | 12 | 12 | 13 |
| 40 | 14 | 14 | 15 | 16 | 16 |
| 50 | 17 | 18 | 18 | 19 | 20 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 4 | 4 | 5 | 6 | 6 |
| 20 | 7 | 8 | 8 | 9 | 10 |
| 30 | 11 | 11 | 12 | 13 | 13 |
| 40 | 14 | 15 | 15 | 16 | 17 |
| 50 | 18 | 18 | 19 | 20 | 20 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 4 | 4 | 5 | 6 | 6 |
| 20 | 7 | 8 | 9 | 9 | 10 |
| 30 | 11 | 11 | 12 | 13 | 13 |
| 40 | 14 | 15 | 16 | 16 | 17 |
| 50 | 18 | 19 | 19 | 20 | 21 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 4 | 4 | 5 | 6 | 7 |
| 20 | 7 | 8 | 9 | 9 | 10 |
| 30 | 11 | 12 | 12 | 13 | 14 |
| 40 | 15 | 15 | 16 | 17 | 17 |
| 50 | 18 | 19 | 20 | 20 | 21 |
| 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 4 | 4 | 5 | 6 | 7 |
| 20 | 7 | 8 | 9 | 10 | 10 |
| 30 | 11 | 12 | 13 | 13 | 14 |
| 40 | 15 | 16 | 16 | 17 | 18 |
| 50 | 19 | 19 | 20 | 21 | 22 |

| Add for Alt. of SUN. | ° | ″ |
|---|---|---|
| | 3 | 8 |
| | 4 | 5 |
| | 5 | 4 |
| | 6 | 3 |
| | 7 | 2 |
| | 8 | 2 |
| | 9 | 2 |
| | 10 | 2 |
| | 20 | 2 |
| | 30 | 3 |
| | 40 | 3 |
| | 50 | 4 |
| | 60 | 4 |
| | 70 | 5 |
| | 80 | 5 |
| | 90 | 5 |

| Add for Alt. of STAR. | ° | ″ |
|---|---|---|
| | 3 | 8 |
| | 4 | 5 |
| | 5 | 4 |
| | 6 | 3 |
| | 7 | 2 |
| | 8 | 2 |
| | 9 | 1 |
| | 10 | 1 |
| | 20 | 0 |
| | 30 | 0 |
| | 40 | 0 |
| | 50 | 0 |
| | 60 | 0 |
| | 70 | 0 |
| | 80 | 0 |
| | 90 | 0 |

Add for Minutes of Moon's Alt. { 1′ 2′ 3′ 4′ 5′ 6′ 7′ 8′ 9′ / 0″ 1″ 1″ 2″ 2″ 3″ 3″ 4″ 4″ }

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ | Add for Minutes of Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ″ | ″ | ″ | ″ | ′ ″ |
| 40 0 | 39 18 | 40 4 | 40 50 | 41 36 | 42 22 | 43 8 | 43 54 | 44 40 | 45 26 | 0 0 | 1 | 3 | 5 | 6 | |
| 10 | 39 12 | 39 58 | 40 44 | 41 30 | 42 16 | 43 2 | 43 48 | 44 34 | 45 19 | 10 8 | 9 | 11 | 12 | 14 | 0 10 |
| 20 | 39 7 | 39 53 | 40 39 | 41 24 | 42 10 | 42 56 | 43 41 | 44 27 | 45 13 | 20 15 | 17 | 18 | 20 | 21 | 1 9 |
| 30 | 39 1 | 39 47 | 40 33 | 41 18 | 42 4 | 42 50 | 43 35 | 44 21 | 45 7 | 30 23 | 24 | 26 | 27 | 29 | 2 9 |
| 40 | 38 56 | 39 41 | 40 27 | 41 12 | 41 58 | 42 43 | 43 29 | 44 14 | 45 0 | 40 30 | 32 | 33 | 35 | 36 | 3 8 |
| 50 | 38 51 | 39 36 | 40 21 | 41 6 | 41 52 | 42 37 | 43 23 | 44 8 | 44 53 | 50 38 | 40 | 41 | 43 | 44 | 4 8 |
| 41 0 | 38 45 | 39 30 | 40 15 | 41 0 | 41 46 | 42 31 | 43 16 | 44 1 | 44 47 | 0 0 | 1 | 3 | 4 | 6 | 5 7 |
| 10 | 38 39 | 39 24 | 40 9 | 40 54 | 41 40 | 42 25 | 43 10 | 43 55 | 44 40 | 10 7 | 9 | 10 | 12 | 13 | 6 6 |
| 20 | 38 34 | 39 18 | 40 3 | 40 48 | 41 33 | 42 18 | 43 3 | 43 48 | 44 33 | 20 15 | 16 | 18 | 19 | 21 | 7 6 |
| 30 | 38 28 | 39 12 | 39 57 | 40 42 | 41 27 | 42 12 | 42 57 | 43 42 | 44 27 | 30 22 | 24 | 25 | 27 | 28 | 8 5 |
| 40 | 38 22 | 39 6 | 39 51 | 40 36 | 41 21 | 42 6 | 42 50 | 43 35 | 44 20 | 40 30 | 31 | 33 | 34 | 36 | 9 5 |
| 50 | 38 16 | 39 1 | 39 45 | 40 30 | 41 15 | 41 59 | 42 44 | 43 29 | 44 13 | 50 37 | 39 | 40 | 42 | 43 | |
| 42 0 | 38 10 | 38 55 | 39 39 | 40 24 | 41 8 | 41 53 | 42 38 | 43 22 | 44 7 | 0 0 | 1 | 3 | 4 | 6 | |
| 10 | 38 4 | 38 49 | 39 33 | 40 18 | 41 2 | 41 46 | 42 31 | 43 15 | 44 0 | 10 7 | 9 | 10 | 12 | 13 | ′ ″ |
| 20 | 37 59 | 38 43 | 39 27 | 40 11 | 40 56 | 41 40 | 42 24 | 43 9 | 43 53 | 20 15 | 16 | 18 | 19 | 21 | 0 10 |
| 30 | 37 53 | 38 37 | 39 21 | 40 5 | 40 49 | 41 34 | 42 18 | 43 2 | 43 46 | 30 22 | 24 | 25 | 27 | 28 | 1 9 |
| 40 | 37 47 | 38 31 | 39 15 | 39 59 | 40 43 | 41 27 | 42 11 | 42 55 | 43 39 | 40 29 | 31 | 32 | 34 | 35 | 2 9 |
| 50 | 37 41 | 38 25 | 39 9 | 39 53 | 40 37 | 41 21 | 42 5 | 42 49 | 43 33 | 50 37 | 38 | 40 | 41 | 43 | 3 8 |
| 43 0 | 37 35 | 38 19 | 39 2 | 39 46 | 40 30 | 41 14 | 41 58 | 42 42 | 43 26 | 0 0 | 1 | 3 | 4 | 6 | 4 8 |
| 10 | 37 29 | 38 12 | 38 56 | 39 40 | 40 24 | 41 7 | 41 51 | 42 35 | 43 19 | 10 7 | 9 | 10 | 12 | 13 | 5 7 |
| 20 | 37 23 | 38 6 | 38 50 | 39 34 | 40 17 | 41 1 | 41 45 | 42 28 | 43 12 | 20 15 | 16 | 17 | 19 | 20 | 6 6 |
| 30 | 37 17 | 38 0 | 38 44 | 39 27 | 40 11 | 40 54 | 41 38 | 42 21 | 43 5 | 30 22 | 23 | 25 | 26 | 28 | 7 6 |
| 40 | 37 11 | 37 54 | 38 37 | 39 21 | 40 4 | 40 48 | 41 31 | 42 14 | 42 58 | 40 29 | 30 | 32 | 33 | 35 | 8 5 |
| 50 | 37 5 | 37 48 | 38 31 | 39 14 | 39 58 | 40 41 | 41 24 | 42 8 | 42 51 | 50 36 | 38 | 39 | 41 | 42 | 9 4 |
| 44 0 | 36 58 | 37 42 | 38 25 | 39 8 | 39 51 | 40 34 | 41 17 | 42 1 | 42 44 | 0 0 | 1 | 3 | 4 | 6 | |
| 10 | 36 52 | 37 35 | 38 18 | 39 1 | 39 44 | 40 27 | 41 10 | 41 54 | 42 37 | 10 7 | 9 | 10 | 11 | 13 | ′ ″ |
| 20 | 36 46 | 37 29 | 38 12 | 38 55 | 39 38 | 40 21 | 41 4 | 41 47 | 42 30 | 20 14 | 16 | 17 | 19 | 20 | 0 10 |
| 30 | 36 40 | 37 23 | 38 6 | 38 49 | 39 31 | 40 14 | 40 57 | 41 40 | 42 23 | 30 21 | 23 | 24 | 26 | 27 | 1 9 |
| 40 | 36 35 | 37 17 | 37 59 | 38 42 | 39 25 | 40 7 | 40 50 | 41 33 | 42 15 | 40 29 | 30 | 31 | 33 | 34 | 2 9 |
| 50 | 36 29 | 37 10 | 37 53 | 38 36 | 39 18 | 40 1 | 40 43 | 41 26 | 42 8 | 50 36 | 37 | 39 | 40 | 41 | 3 8 |
| 45 0 | 36 22 | 37 4 | 37 46 | 38 29 | 39 11 | 39 54 | 40 36 | 41 19 | 42 1 | 0 0 | 1 | 3 | 4 | 6 | 4 8 |
| 10 | 36 15 | 36 58 | 37 40 | 38 22 | 39 5 | 39 47 | 40 29 | 41 12 | 41 54 | 10 7 | 8 | 10 | 11 | 13 | 5 7 |
| 20 | 36 9 | 36 51 | 37 34 | 38 16 | 38 58 | 39 40 | 40 22 | 41 4 | 41 47 | 20 14 | 15 | 17 | 18 | 20 | 6 6 |
| 30 | 36 3 | 36 45 | 37 27 | 38 9 | 38 51 | 39 33 | 40 15 | 40 57 | 41 39 | 30 21 | 22 | 24 | 25 | 27 | 7 6 |
| 40 | 35 56 | 36 39 | 37 21 | 38 2 | 38 44 | 39 26 | 40 8 | 40 50 | 41 32 | 40 28 | 29 | 31 | 32 | 34 | 8 5 |
| 50 | 35 50 | 36 32 | 37 14 | 37 56 | 38 38 | 39 19 | 40 1 | 40 43 | 41 25 | 50 35 | 36 | 38 | 39 | 41 | 9 4 |
| 46 0 | 35 44 | 36 26 | 37 7 | 37 49 | 38 31 | 39 12 | 39 54 | 40 36 | 41 17 | 0 0 | 1 | 3 | 4 | 6 | |
| 10 | 35 37 | 36 19 | 37 1 | 37 42 | 38 24 | 39 5 | 39 47 | 40 29 | 41 10 | 10 7 | 8 | 10 | 11 | 12 | ′ ″ |
| 20 | 35 31 | 36 13 | 36 54 | 37 36 | 38 17 | 38 58 | 39 40 | 40 21 | 41 3 | 20 14 | 15 | 17 | 18 | 19 | 0 10 |
| 30 | 35 25 | 36 6 | 36 48 | 37 29 | 38 10 | 38 51 | 39 33 | 40 14 | 40 55 | 30 21 | 22 | 23 | 25 | 26 | 1 9 |
| 40 | 35 18 | 35 59 | 36 41 | 37 22 | 38 3 | 38 44 | 39 26 | 40 7 | 40 48 | 40 28 | 29 | 30 | 32 | 33 | 2 9 |
| 50 | 35 12 | 35 53 | 36 34 | 37 15 | 37 56 | 38 37 | 39 18 | 39 59 | 40 40 | 50 34 | 36 | 37 | 39 | 40 | 3 8 |
| 47 0 | 35 6 | 35 47 | 36 28 | 37 9 | 37 49 | 38 30 | 39 11 | 39 52 | 40 33 | 0 0 | 1 | 3 | 4 | 5 | 4 7 |
| 10 | 34 59 | 35 40 | 36 21 | 37 2 | 37 42 | 38 23 | 39 4 | 39 45 | 40 26 | 10 7 | 8 | 9 | 11 | 12 | 5 6 |
| 20 | 34 53 | 35 33 | 36 14 | 36 55 | 37 35 | 38 16 | 38 57 | 39 37 | 40 18 | 20 14 | 15 | 16 | 18 | 19 | 6 6 |
| 30 | 34 46 | 35 27 | 36 7 | 36 48 | 37 28 | 38 9 | 38 49 | 39 30 | 40 10 | 30 20 | 22 | 23 | 24 | 26 | 7 5 |
| 40 | 34 40 | 35 20 | 36 0 | 36 41 | 37 21 | 38 2 | 38 42 | 39 23 | 40 3 | 40 27 | 28 | 30 | 31 | 32 | 8 4 |
| 50 | 34 34 | 35 13 | 35 53 | 36 34 | 37 14 | 37 55 | 38 35 | 39 15 | 39 55 | 50 34 | 35 | 37 | 38 | 39 | 9 4 |
| 48 0 | 34 27 | 35 7 | 35 47 | 36 27 | 37 7 | 37 47 | 38 27 | 39 8 | 39 48 | 0 0 | 1 | 3 | 4 | 5 | |
| 10 | 34 20 | 35 0 | 35 40 | 36 20 | 37 0 | 37 40 | 38 20 | 39 0 | 39 40 | 10 7 | 8 | 9 | 11 | 12 | ′ ″ |
| 20 | 34 14 | 34 53 | 35 33 | 36 13 | 36 53 | 37 33 | 38 13 | 38 53 | 39 32 | 20 13 | 15 | 16 | 17 | 19 | 0 10 |
| 30 | 34 7 | 34 46 | 35 26 | 36 6 | 36 47 | 37 26 | 38 5 | 38 45 | 39 25 | 30 20 | 21 | 23 | 24 | 25 | 1 9 |
| 40 | 34 0 | 34 40 | 35 19 | 35 59 | 36 39 | 37 18 | 37 58 | 38 37 | 39 17 | 40 27 | 28 | 29 | 30 | 32 | 2 9 |
| 50 | 33 54 | 34 33 | 35 12 | 35 52 | 36 31 | 37 11 | 37 50 | 38 30 | 39 9 | 50 33 | 34 | 36 | 37 | 38 | 3 8 |
| 49 0 | 33 47 | 34 26 | 35 5 | 35 45 | 36 24 | 37 4 | 37 43 | 38 22 | 39 2 | 0 0 | 1 | 3 | 4 | 5 | 4 7 |
| 10 | 33 40 | 34 19 | 34 59 | 35 38 | 36 17 | 36 56 | 37 35 | 38 15 | 38 54 | 10 6 | 8 | 9 | 10 | 12 | 5 6 |
| 20 | 33 33 | 34 12 | 34 52 | 35 31 | 36 10 | 36 49 | 37 28 | 38 7 | 38 46 | 20 13 | 14 | 16 | 17 | 18 | 6 6 |
| 30 | 33 26 | 34 6 | 34 45 | 35 24 | 36 2 | 36 41 | 37 20 | 37 59 | 38 38 | 30 19 | 21 | 22 | 23 | 25 | 7 5 |
| 40 | 33 19 | 33 59 | 34 38 | 35 16 | 35 55 | 36 34 | 37 13 | 37 52 | 38 31 | 40 26 | 27 | 29 | 30 | 31 | 8 4 |
| 50 | 33 13 | 33 52 | 34 30 | 35 9 | 35 48 | 36 27 | 37 5 | 37 44 | 38 23 | 50 32 | 34 | 35 | 36 | 38 | 9 4 |

# TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 40 0 | 18 41 | 19 3 | 19 26 | 19 48 | 20 11 | 20 33 | 20 56 | 21 18 | 21 41 |
| 10 | 18 45 | 19 8 | 19 30 | 19 53 | 20 15 | 20 38 | 21 0 | 21 23 | 21 45 |
| 20 | 18 49 | 19 12 | 19 34 | 19 57 | 20 20 | 20 42 | 21 5 | 21 28 | 21 50 |
| 30 | 18 53 | 19 16 | 19 38 | 20 1 | 20 24 | 20 47 | 21 9 | 21 32 | 21 55 |
| 40 | 18 57 | 19 20 | 19 42 | 20 5 | 20 28 | 20 51 | 21 14 | 21 37 | 22 0 |
| 50 | 19 1 | 19 24 | 19 47 | 20 9 | 20 32 | 20 55 | 21 18 | 21 41 | 22 4 |
| 41 0 | 19 5 | 19 28 | 19 51 | 20 14 | 20 37 | 21 0 | 21 23 | 21 46 | 22 9 |
| 10 | 19 9 | 19 32 | 19 55 | 20 18 | 20 41 | 21 4 | 21 27 | 21 50 | 22 13 |
| 20 | 19 13 | 19 36 | 19 59 | 20 22 | 20 45 | 21 8 | 21 31 | 21 55 | 22 18 |
| 30 | 19 17 | 19 40 | 20 3 | 20 26 | 20 50 | 21 13 | 21 36 | 21 59 | 22 22 |
| 40 | 19 21 | 19 44 | 20 7 | 20 31 | 20 54 | 21 17 | 21 40 | 22 4 | 22 27 |
| 50 | 19 25 | 19 48 | 20 11 | 20 35 | 20 58 | 21 21 | 21 45 | 22 8 | 22 31 |
| 42 0 | 19 29 | 19 52 | 20 15 | 20 39 | 21 2 | 21 26 | 21 49 | 22 13 | 22 36 |
| 10 | 19 32 | 19 56 | 20 20 | 20 43 | 21 7 | 21 30 | 21 53 | 22 17 | 22 40 |
| 20 | 19 36 | 20 0 | 20 24 | 20 47 | 21 11 | 21 34 | 21 58 | 22 21 | 22 45 |
| 30 | 19 40 | 20 4 | 20 28 | 20 51 | 21 15 | 21 38 | 22 2 | 22 26 | 22 49 |
| 40 | 19 44 | 20 8 | 20 32 | 20 55 | 21 19 | 21 43 | 22 6 | 22 30 | 22 54 |
| 50 | 19 48 | 20 12 | 20 36 | 20 59 | 21 23 | 21 47 | 22 11 | 22 34 | 22 58 |
| 43 0 | 19 52 | 20 16 | 20 40 | 21 3 | 21 27 | 21 51 | 22 15 | 22 39 | 23 3 |
| 10 | 19 56 | 20 20 | 20 44 | 21 7 | 21 31 | 21 55 | 22 19 | 22 43 | 23 7 |
| 20 | 20 0 | 20 24 | 20 48 | 21 11 | 21 35 | 21 59 | 22 23 | 22 47 | 23 11 |
| 30 | 20 3 | 20 27 | 20 51 | 21 15 | 21 39 | 22 4 | 22 28 | 22 52 | 23 16 |
| 40 | 20 7 | 20 31 | 20 55 | 21 20 | 21 44 | 22 8 | 22 32 | 22 56 | 23 20 |
| 50 | 20 11 | 20 35 | 21 0 | 21 24 | 21 48 | 22 12 | 22 36 | 23 0 | 23 25 |
| 44 0 | 20 15 | 20 39 | 21 3 | 21 28 | 21 52 | 22 16 | 22 41 | 23 5 | 23 29 |
| 10 | 20 19 | 20 43 | 21 7 | 21 32 | 21 56 | 22 20 | 22 45 | 23 9 | 23 33 |
| 20 | 20 22 | 20 47 | 21 11 | 21 36 | 22 0 | 22 24 | 22 49 | 23 13 | 23 38 |
| 30 | 20 26 | 20 51 | 21 15 | 21 40 | 22 4 | 22 28 | 22 53 | 23 18 | 23 42 |
| 40 | 20 30 | 20 54 | 21 19 | 21 44 | 22 8 | 22 33 | 22 57 | 23 22 | 23 46 |
| 50 | 20 34 | 20 58 | 21 23 | 21 47 | 22 12 | 22 37 | 23 1 | 23 26 | 23 50 |
| 45 0 | 20 37 | 21 2 | 21 27 | 21 51 | 22 16 | 22 41 | 23 5 | 23 30 | 23 55 |
| 10 | 20 41 | 21 6 | 21 31 | 21 55 | 22 20 | 22 45 | 23 10 | 23 34 | 23 59 |
| 20 | 20 45 | 21 10 | 21 34 | 21 59 | 22 24 | 22 49 | 23 14 | 23 39 | 24 3 |
| 30 | 20 48 | 21 13 | 21 38 | 22 3 | 22 28 | 22 53 | 23 18 | 23 43 | 24 8 |
| 40 | 20 52 | 21 17 | 21 42 | 22 7 | 22 32 | 22 57 | 23 22 | 23 47 | 24 12 |
| 50 | 20 56 | 21 21 | 21 46 | 22 11 | 22 36 | 23 1 | 23 26 | 23 51 | 24 16 |
| 46 0 | 21 0 | 21 25 | 21 50 | 22 15 | 22 40 | 23 5 | 23 30 | 23 55 | 24 20 |
| 10 | 21 3 | 21 28 | 21 54 | 22 19 | 22 44 | 23 9 | 23 34 | 23 59 | 24 25 |
| 20 | 21 7 | 21 32 | 21 57 | 22 23 | 22 48 | 23 13 | 23 38 | 24 3 | 24 29 |
| 30 | 21 10 | 21 36 | 22 1 | 22 26 | 22 52 | 23 17 | 23 42 | 24 8 | 24 33 |
| 40 | 21 14 | 21 40 | 22 5 | 22 30 | 22 56 | 23 21 | 23 46 | 24 12 | 24 37 |
| 50 | 21 18 | 21 43 | 22 8 | 22 34 | 22 59 | 23 25 | 23 50 | 24 16 | 24 41 |
| 47 0 | 21 21 | 21 47 | 22 12 | 22 38 | 23 3 | 23 29 | 23 54 | 24 20 | 24 45 |
| 10 | 21 25 | 21 50 | 22 16 | 22 42 | 23 7 | 23 33 | 23 58 | 24 24 | 24 49 |
| 20 | 21 28 | 21 54 | 22 20 | 22 45 | 23 11 | 23 37 | 24 2 | 24 28 | 24 54 |
| 30 | 21 32 | 21 58 | 22 23 | 22 49 | 23 15 | 23 41 | 24 6 | 24 32 | 24 58 |
| 40 | 21 35 | 22 1 | 22 27 | 22 53 | 23 19 | 23 44 | 24 10 | 24 36 | 25 2 |
| 50 | 21 39 | 22 5 | 22 31 | 22 57 | 23 22 | 23 48 | 24 14 | 24 40 | 25 6 |
| 48 0 | 21 43 | 22 8 | 22 34 | 23 0 | 23 26 | 23 52 | 24 18 | 24 44 | 25 10 |
| 10 | 21 46 | 22 12 | 22 38 | 23 4 | 23 30 | 23 56 | 24 22 | 24 48 | 25 14 |
| 20 | 21 50 | 22 16 | 22 42 | 23 8 | 23 34 | 24 0 | 24 26 | 24 52 | 25 18 |
| 30 | 21 53 | 22 19 | 22 45 | 23 11 | 23 38 | 24 4 | 24 30 | 24 56 | 25 22 |
| 40 | 21 57 | 22 23 | 22 49 | 23 15 | 23 41 | 24 7 | 24 34 | 25 0 | 25 26 |
| 50 | 22 0 | 22 26 | 22 52 | 23 19 | 23 45 | 24 11 | 24 37 | 25 4 | 25 30 |
| 49 0 | 22 4 | 22 30 | 22 56 | 23 22 | 23 49 | 24 15 | 24 41 | 25 8 | 25 34 |
| 10 | 22 7 | 22 33 | 23 0 | 23 26 | 23 52 | 24 19 | 24 45 | 25 11 | 25 38 |
| 20 | 22 11 | 22 37 | 23 3 | 23 30 | 23 56 | 24 23 | 24 49 | 25 15 | 25 42 |
| 30 | 22 14 | 22 40 | 23 7 | 23 34 | 24 0 | 24 26 | 24 53 | 25 19 | 25 46 |
| 40 | 22 17 | 22 44 | 23 11 | 23 37 | 24 3 | 24 30 | 24 57 | 25 23 | 25 50 |
| 50 | 22 21 | 22 47 | 23 14 | 23 41 | 24 7 | 24 34 | 25 0 | 25 27 | 25 54 |

| Add for Sec. of Par. | 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|---|
| | ″ | ′ ″ | ″ | ″ | ″ |
| 0 | 0 | 1 | 2 | 2 | 3 |
| 10 | 4 | 5 | 5 | 6 | 7 |
| 20 | 8 | 8 | 9 | 10 | 11 |
| 30 | 11 | 12 | 13 | 14 | 14 |
| 40 | 15 | 16 | 17 | 17 | 18 |
| 50 | 19 | 20 | 20 | 21 | 22 |

Add for Alt. of SUN.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 80 | 5 |
| 90 | 5 |

Add for Alt. of STAR.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 1 |
| 10 | 1 |
| 20 | 0 |
| 30 | 0 |
| 40 | 0 |
| 50 | 0 |
| 60 | 0 |
| 70 | 0 |
| 80 | 0 |
| 90 | 0 |

| Add for Minutes of Moon's Alt. | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |
|---|---|---|---|---|---|---|---|---|---|
| | 0″ | 1″ | 1″ | 2″ | 2″ | 2″ | 3″ | 3″ | 4″ |

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 50 0 | 33 6 | 33 45 | 34 23 | 35 2 | 35 41 | 36 19 | 36 58 | 37 36 | 38 15 |
| 10 | 32 59 | 33 38 | 34 16 | 34 55 | 35 33 | 36 12 | 36 50 | 37 29 | 38 7 |
| 20 | 32 53 | 33 31 | 34 9 | 34 48 | 35 26 | 36 4 | 36 42 | 37 21 | 37 59 |
| 30 | 32 46 | 33 24 | 34 2 | 34 40 | 35 18 | 35 57 | 36 35 | 37 13 | 37 51 |
| 40 | 32 39 | 33 17 | 33 55 | 34 33 | 35 11 | 35 49 | 36 27 | 37 5 | 37 43 |
| 50 | 32 32 | 33 10 | 33 48 | 34 26 | 35 4 | 35 42 | 36 19 | 36 57 | 37 35 |
| 51 0 | 32 25 | 33 3 | 33 41 | 34 18 | 34 56 | 35 34 | 36 12 | 36 49 | 37 27 |
| 10 | 32 18 | 32 56 | 33 33 | 34 11 | 34 49 | 35 26 | 36 4 | 36 42 | 37 19 |
| 20 | 32 11 | 32 49 | 33 26 | 34 4 | 34 41 | 35 19 | 35 56 | 36 34 | 37 11 |
| 30 | 32 4 | 32 42 | 33 19 | 33 56 | 34 34 | 35 11 | 35 49 | 36 26 | 37 3 |
| 40 | 31 57 | 32 35 | 33 12 | 33 49 | 34 26 | 35 3 | 35 41 | 36 18 | 36 55 |
| 50 | 31 50 | 32 27 | 33 4 | 33 42 | 34 19 | 34 56 | 35 33 | 36 10 | 36 47 |
| 52 0 | 31 43 | 32 20 | 32 57 | 33 34 | 34 11 | 34 48 | 35 25 | 36 2 | 36 39 |
| 10 | 31 36 | 32 13 | 32 50 | 33 27 | 34 3 | 34 40 | 35 17 | 35 54 | 36 31 |
| 20 | 31 29 | 32 6 | 32 43 | 33 19 | 33 56 | 34 33 | 35 9 | 35 46 | 36 23 |
| 30 | 31 22 | 31 59 | 32 35 | 33 12 | 33 48 | 34 25 | 35 1 | 35 38 | 36 14 |
| 40 | 31 15 | 31 51 | 32 28 | 33 4 | 33 41 | 34 17 | 34 53 | 35 30 | 36 6 |
| 50 | 31 8 | 31 44 | 32 20 | 32 57 | 33 33 | 34 9 | 34 45 | 35 22 | 35 58 |
| 53 0 | 31 1 | 31 37 | 32 13 | 32 49 | 33 25 | 34 1 | 34 38 | 35 14 | 35 50 |
| 10 | 30 53 | 31 30 | 32 6 | 32 42 | 33 18 | 33 54 | 34 30 | 35 5 | 35 41 |
| 20 | 30 46 | 31 22 | 31 58 | 32 34 | 33 10 | 33 46 | 34 22 | 34 57 | 35 33 |
| 30 | 30 39 | 31 15 | 31 51 | 32 26 | 33 2 | 33 38 | 34 14 | 34 49 | 35 25 |
| 40 | 30 32 | 31 8 | 31 43 | 32 19 | 32 54 | 33 30 | 34 5 | 34 41 | 35 17 |
| 50 | 30 25 | 31 0 | 31 36 | 32 11 | 32 47 | 33 22 | 33 57 | 34 33 | 35 8 |
| 54 0 | 30 18 | 30 53 | 31 28 | 32 3 | 32 39 | 33 14 | 33 49 | 34 25 | 35 0 |
| 10 | 30 11 | 30 46 | 31 21 | 31 56 | 32 31 | 33 6 | 33 41 | 34 16 | 34 52 |
| 20 | 30 3 | 30 38 | 31 13 | 31 48 | 32 23 | 32 58 | 33 33 | 34 8 | 34 43 |
| 30 | 29 56 | 30 31 | 31 6 | 31 41 | 32 15 | 32 50 | 33 25 | 34 0 | 34 35 |
| 40 | 29 49 | 30 23 | 30 58 | 31 33 | 32 8 | 32 42 | 33 17 | 33 52 | 34 26 |
| 50 | 29 42 | 30 16 | 30 51 | 31 25 | 32 0 | 32 34 | 33 9 | 33 43 | 34 18 |
| 55 0 | 29 34 | 30 9 | 30 43 | 31 17 | 31 52 | 32 26 | 33 1 | 33 35 | 34 9 |
| 10 | 29 26 | 30 1 | 30 35 | 31 10 | 31 44 | 32 18 | 32 52 | 33 27 | 34 1 |
| 20 | 29 19 | 29 54 | 30 28 | 31 2 | 31 36 | 32 10 | 32 44 | 33 18 | 33 52 |
| 30 | 29 11 | 29 46 | 30 20 | 30 54 | 31 28 | 32 2 | 32 36 | 33 10 | 33 44 |
| 40 | 29 4 | 29 38 | 30 12 | 30 46 | 31 20 | 31 54 | 32 27 | 33 2 | 33 35 |
| 50 | 28 57 | 29 31 | 30 5 | 30 38 | 31 12 | 31 46 | 32 19 | 32 53 | 33 27 |
| 56 0 | 28 50 | 29 23 | 29 57 | 30 30 | 31 4 | 31 38 | 32 11 | 32 45 | 33 18 |
| 10 | 28 43 | 29 16 | 29 49 | 30 23 | 30 56 | 31 29 | 32 3 | 32 36 | 33 10 |
| 20 | 28 35 | 29 8 | 29 41 | 30 15 | 30 48 | 31 21 | 31 54 | 32 28 | 33 1 |
| 30 | 28 27 | 29 1 | 29 34 | 30 7 | 30 40 | 31 13 | 31 46 | 32 19 | 32 52 |
| 40 | 28 20 | 28 53 | 29 26 | 29 59 | 30 32 | 31 5 | 31 38 | 32 11 | 32 44 |
| 50 | 28 13 | 28 45 | 29 18 | 29 51 | 30 24 | 30 57 | 31 29 | 32 2 | 32 35 |
| 57 0 | 28 5 | 28 38 | 29 10 | 29 43 | 30 16 | 30 48 | 31 21 | 31 54 | 32 26 |
| 10 | 27 57 | 28 30 | 29 2 | 29 35 | 30 8 | 30 40 | 31 13 | 31 45 | 32 18 |
| 20 | 27 50 | 28 22 | 28 55 | 29 27 | 29 59 | 30 32 | 31 4 | 31 37 | 32 9 |
| 30 | 27 43 | 28 15 | 28 47 | 29 19 | 29 51 | 30 24 | 30 56 | 31 28 | 32 0 |
| 40 | 27 35 | 28 7 | 28 39 | 29 11 | 29 43 | 30 15 | 30 47 | 31 19 | 31 51 |
| 50 | 27 28 | 27 59 | 28 31 | 29 3 | 29 35 | 30 7 | 30 39 | 31 11 | 31 43 |
| 58 0 | 27 20 | 27 51 | 28 23 | 28 55 | 29 27 | 29 59 | 30 30 | 31 2 | 31 34 |
| 10 | 27 12 | 27 44 | 28 15 | 28 47 | 29 19 | 29 50 | 30 22 | 30 53 | 31 25 |
| 20 | 27 4 | 27 36 | 28 7 | 28 39 | 29 10 | 29 42 | 30 13 | 30 45 | 31 16 |
| 30 | 26 57 | 27 28 | 27 59 | 28 31 | 29 2 | 29 33 | 30 5 | 30 36 | 31 7 |
| 40 | 26 50 | 27 20 | 27 51 | 28 23 | 28 54 | 29 25 | 29 56 | 30 27 | 30 59 |
| 50 | 26 42 | 27 12 | 27 43 | 28 14 | 28 45 | 29 17 | 29 48 | 30 19 | 30 50 |
| 59 0 | 26 34 | 27 5 | 27 35 | 28 6 | 28 37 | 29 8 | 29 39 | 30 10 | 30 41 |
| 10 | 26 26 | 26 57 | 27 27 | 27 58 | 28 29 | 29 0 | 29 30 | 30 1 | 30 32 |
| 20 | 26 18 | 26 49 | 27 19 | 27 50 | 28 21 | 28 51 | 29 22 | 29 52 | 30 23 |
| 30 | 26 10 | 26 41 | 27 11 | 27 42 | 28 12 | 28 43 | 29 13 | 29 44 | 30 14 |
| 40 | 26 3 | 26 33 | 27 3 | 27 34 | 28 4 | 28 34 | 29 4 | 29 35 | 30 5 |
| 50 | 25 55 | 26 25 | 26 55 | 27 25 | 27 56 | 28 26 | 28 56 | 29 26 | 29 56 |

| Add for Sec. of Par. | 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|---|
| | ″ | ″ | ″ | ″ | ″ |
| 0 | 0 | 1 | 3 | 4 | 5 |
| 10 | 6 | 8 | 9 | 10 | 11 |
| 20 | 13 | 14 | 15 | 17 | 18 |
| 30 | 19 | 20 | 22 | 23 | 24 |
| 40 | 25 | 27 | 28 | 29 | 31 |
| 50 | 32 | 33 | 34 | 36 | 37 |
| 0 | 0 | 1 | 2 | 4 | 5 |
| 10 | 6 | 7 | 9 | 10 | 11 |
| 20 | 12 | 14 | 15 | 16 | 17 |
| 30 | 19 | 20 | 21 | 22 | 24 |
| 40 | 25 | 26 | 28 | 29 | 30 |
| 50 | 31 | 32 | 34 | 35 | 36 |
| 0 | 0 | 1 | 2 | 4 | 5 |
| 10 | 6 | 7 | 9 | 10 | 11 |
| 20 | 12 | 13 | 15 | 16 | 17 |
| 30 | 18 | 19 | 21 | 22 | 23 |
| 40 | 24 | 26 | 27 | 28 | 29 |
| 50 | 30 | 32 | 33 | 34 | 35 |
| 0 | 0 | 1 | 2 | 4 | 5 |
| 10 | 6 | 7 | 8 | 10 | 11 |
| 20 | 12 | 13 | 14 | 15 | 17 |
| 30 | 18 | 19 | 20 | 21 | 23 |
| 40 | 24 | 25 | 26 | 27 | 29 |
| 50 | 30 | 31 | 32 | 33 | 35 |
| 0 | 0 | 1 | 2 | 3 | 5 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 12 | 13 | 14 | 15 | 16 |
| 30 | 17 | 19 | 20 | 21 | 22 |
| 40 | 23 | 24 | 26 | 27 | 28 |
| 50 | 29 | 30 | 31 | 32 | 34 |
| 0 | 0 | 1 | 2 | 3 | 5 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 14 | 15 | 16 |
| 30 | 17 | 18 | 19 | 20 | 22 |
| 40 | 23 | 24 | 25 | 26 | 27 |
| 50 | 28 | 29 | 31 | 32 | 33 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 15 |
| 30 | 17 | 18 | 19 | 20 | 21 |
| 40 | 22 | 23 | 24 | 25 | 26 |
| 50 | 28 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 5 | 6 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 15 |
| 30 | 16 | 17 | 18 | 19 | 20 |
| 40 | 21 | 23 | 24 | 25 | 26 |
| 50 | 27 | 28 | 29 | 30 | 31 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 10 | 11 | 13 | 14 | 15 |
| 30 | 16 | 17 | 18 | 19 | 20 |
| 40 | 21 | 22 | 23 | 24 | 25 |
| 50 | 26 | 27 | 28 | 29 | 30 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 10 | 11 | 12 | 13 | 14 |
| 30 | 15 | 16 | 17 | 18 | 19 |
| 40 | 20 | 21 | 22 | 23 | 24 |
| 50 | 25 | 26 | 27 | 28 | 29 |

| Add for Minutes of Alt. | ′ | ″ |
|---|---|---|
| 0 | 0 | 10 |
| 1 | 1 | 9 |
| 2 | 2 | 8 |
| 3 | 3 | 8 |
| 4 | 4 | 7 |
| 5 | 5 | 6 |
| 6 | 6 | 6 |
| 7 | 7 | 5 |
| 8 | 8 | 4 |
| 9 | 9 | 3 |
| 0 | 0 | 10 |
| 1 | 1 | 9 |
| 2 | 2 | 8 |
| 3 | 3 | 8 |
| 4 | 4 | 7 |
| 5 | 5 | 6 |
| 6 | 6 | 5 |
| 7 | 7 | 5 |
| 8 | 8 | 4 |
| 9 | 9 | 3 |
| 0 | 0 | 10 |
| 1 | 1 | 9 |
| 2 | 2 | 8 |
| 3 | 3 | 8 |
| 4 | 4 | 7 |
| 5 | 5 | 6 |
| 6 | 6 | 5 |
| 7 | 7 | 4 |
| 8 | 8 | 4 |
| 9 | 9 | 3 |
| 0 | 0 | 10 |
| 1 | 1 | 9 |
| 2 | 2 | 8 |
| 3 | 3 | 8 |
| 4 | 4 | 7 |
| 5 | 5 | 6 |
| 6 | 6 | 5 |
| 7 | 7 | 4 |
| 8 | 8 | 4 |
| 9 | 9 | 3 |
| 0 | 0 | 10 |
| 1 | 1 | 9 |
| 2 | 2 | 8 |
| 3 | 3 | 8 |
| 4 | 4 | 7 |
| 5 | 5 | 6 |
| 6 | 6 | 5 |
| 7 | 7 | 4 |
| 8 | 8 | 3 |
| 9 | 9 | 3 |

# TABLE XXX.*

**Auxiliary Arcs.**—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Add for Sec. of Par 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ″ | ″ | ″ | ″ |
| 50 0 | 22 24 | 22 51 | 23 18 | 23 44 | 24 11 | 24 37 | 25 4 | 25 31 | 25 58 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 22 28 | 22 54 | 23 21 | 23 48 | 24 15 | 24 41 | 25 8 | 25 35 | 26 1 | 10 | 4 | 5 | 6 | 7 | 8 |
| 20 | 22 31 | 22 58 | 23 25 | 23 51 | 24 18 | 24 45 | 25 11 | 25 38 | 26 5 | 20 | 9 | 10 | 11 | 12 | 13 |
| 30 | 22 34 | 23 1 | 23 28 | 23 55 | 24 22 | 24 49 | 25 15 | 25 42 | 26 9 | 30 | 13 | 14 | 15 | 16 | 17 |
| 40 | 22 38 | 23 5 | 23 31 | 23 58 | 24 25 | 24 52 | 25 19 | 25 46 | 26 13 | 40 | 18 | 19 | 20 | 21 | 22 |
| 50 | 22 41 | 23 8 | 23 35 | 24 2 | 24 29 | 24 56 | 25 23 | 25 50 | 26 17 | 50 | 22 | 23 | 24 | 25 | 26 |
| 51 0 | 22 44 | 23 11 | 23 38 | 24 5 | 24 32 | 25 0 | 25 27 | 25 54 | 26 21 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 22 47 | 23 15 | 23 42 | 24 9 | 24 36 | 25 3 | 25 30 | 25 57 | 26 24 | 10 | 5 | 5 | 6 | 7 | 8 |
| 20 | 22 51 | 23 18 | 23 45 | 24 12 | 24 40 | 25 7 | 25 34 | 26 1 | 26 28 | 20 | 9 | 10 | 11 | 12 | 13 |
| 30 | 22 54 | 23 21 | 23 49 | 24 16 | 24 43 | 25 10 | 25 38 | 26 5 | 26 32 | 30 | 14 | 15 | 15 | 16 | 17 |
| 40 | 22 57 | 23 25 | 23 52 | 24 19 | 24 47 | 25 14 | 25 41 | 26 8 | 26 35 | 40 | 18 | 19 | 20 | 21 | 22 |
| 50 | 23 1 | 23 28 | 23 55 | 24 23 | 24 50 | 25 17 | 25 45 | 26 12 | 26 39 | 50 | 23 | 24 | 25 | 25 | 26 |
| 52 0 | 23 4 | 23 31 | 23 59 | 24 26 | 24 54 | 25 21 | 25 48 | 26 16 | 26 43 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 23 7 | 23 35 | 24 2 | 24 30 | 24 57 | 25 24 | 25 52 | 26 19 | 26 47 | 10 | 5 | 6 | 6 | 7 | 8 |
| 20 | 23 10 | 23 38 | 24 5 | 24 33 | 25 0 | 25 28 | 25 55 | 26 23 | 26 50 | 20 | 9 | 10 | 11 | 12 | 13 |
| 30 | 23 14 | 23 41 | 24 9 | 24 36 | 25 4 | 25 31 | 25 59 | 26 27 | 26 54 | 30 | 14 | 15 | 16 | 17 | 17 |
| 40 | 23 17 | 23 44 | 24 12 | 24 40 | 25 7 | 25 35 | 26 3 | 26 30 | 26 58 | 40 | 18 | 19 | 20 | 21 | 22 |
| 50 | 23 20 | 23 48 | 24 15 | 24 43 | 25 11 | 25 38 | 26 6 | 26 34 | 27 1 | 50 | 23 | 24 | 25 | 26 | 27 |
| 53 0 | 23 23 | 23 51 | 24 19 | 24 46 | 25 14 | 25 42 | 26 10 | 26 37 | 27 5 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 23 26 | 23 54 | 24 22 | 24 50 | 25 18 | 25 45 | 26 13 | 26 41 | 27 8 | 10 | 5 | 6 | 7 | 7 | 8 |
| 20 | 23 29 | 23 57 | 24 25 | 24 53 | 25 21 | 25 49 | 26 17 | 26 44 | 27 12 | 20 | 9 | 10 | 11 | 12 | 13 |
| 30 | 23 32 | 24 0 | 24 28 | 24 56 | 25 24 | 25 52 | 26 20 | 26 48 | 27 16 | 30 | 14 | 15 | 16 | 17 | 18 |
| 40 | 23 36 | 24 4 | 24 32 | 25 0 | 25 28 | 25 56 | 26 24 | 26 52 | 27 19 | 40 | 19 | 20 | 21 | 21 | 22 |
| 50 | 23 39 | 24 7 | 24 35 | 25 3 | 25 31 | 25 59 | 26 27 | 26 55 | 27 23 | 50 | 23 | 24 | 25 | 26 | 27 |
| 54 0 | 23 42 | 24 10 | 24 38 | 25 6 | 25 34 | 26 2 | 26 30 | 26 59 | 27 27 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 23 45 | 24 13 | 24 41 | 25 10 | 25 38 | 26 6 | 26 34 | 27 2 | 27 30 | 10 | 5 | 6 | 7 | 8 | 8 |
| 20 | 23 48 | 24 16 | 24 44 | 25 13 | 25 41 | 26 9 | 26 37 | 27 5 | 27 34 | 20 | 9 | 10 | 11 | 12 | 13 |
| 30 | 23 51 | 24 19 | 24 48 | 25 16 | 25 44 | 26 13 | 26 41 | 27 9 | 27 37 | 30 | 14 | 15 | 16 | 17 | 18 |
| 40 | 23 54 | 24 23 | 24 51 | 25 19 | 25 48 | 26 16 | 26 44 | 27 12 | 27 41 | 40 | 19 | 20 | 21 | 22 | 23 |
| 50 | 23 57 | 24 26 | 24 54 | 25 22 | 25 51 | 26 19 | 26 48 | 27 16 | 27 44 | 50 | 24 | 24 | 25 | 26 | 27 |
| 55 0 | 24 0 | 24 29 | 24 57 | 25 25 | 25 54 | 26 22 | 26 51 | 27 19 | 27 48 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 24 3 | 24 32 | 25 0 | 25 29 | 25 57 | 26 26 | 26 54 | 27 23 | 27 51 | 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 24 6 | 24 35 | 25 3 | 25 32 | 26 0 | 26 29 | 26 58 | 27 26 | 27 55 | 20 | 10 | 10 | 11 | 12 | 13 |
| 30 | 24 9 | 24 38 | 25 6 | 25 35 | 26 4 | 26 32 | 27 1 | 27 29 | 27 58 | 30 | 14 | 15 | 16 | 17 | 18 |
| 40 | 24 12 | 24 41 | 25 10 | 25 38 | 26 7 | 26 35 | 27 4 | 27 33 | 28 1 | 40 | 19 | 20 | 21 | 22 | 23 |
| 50 | 24 15 | 24 44 | 25 13 | 25 41 | 26 10 | 26 39 | 27 7 | 27 36 | 28 5 | 50 | 24 | 25 | 26 | 27 | 28 |
| 56 0 | 24 18 | 24 47 | 25 16 | 25 44 | 26 13 | 26 42 | 27 11 | 27 39 | 28 8 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 24 21 | 24 50 | 25 19 | 25 48 | 26 16 | 26 45 | 27 14 | 27 43 | 28 12 | 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 24 24 | 24 53 | 25 22 | 25 51 | 26 19 | 26 48 | 27 17 | 27 46 | 28 15 | 20 | 10 | 11 | 12 | 12 | 13 |
| 30 | 24 27 | 24 56 | 25 25 | 25 54 | 26 23 | 26 51 | 27 20 | 27 49 | 28 18 | 30 | 14 | 15 | 16 | 17 | 18 |
| 40 | 24 30 | 24 59 | 25 28 | 25 57 | 26 26 | 26 55 | 27 24 | 27 53 | 28 22 | 40 | 19 | 20 | 21 | 22 | 23 |
| 50 | 24 33 | 25 2 | 25 31 | 26 0 | 26 29 | 26 58 | 27 27 | 27 56 | 28 25 | 50 | 24 | 25 | 26 | 27 | 28 |
| 57 0 | 24 35 | 25 4 | 25 34 | 26 3 | 26 32 | 27 1 | 27 30 | 27 59 | 28 28 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 24 38 | 25 7 | 25 36 | 26 6 | 26 35 | 27 4 | 27 33 | 28 2 | 28 31 | 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 24 41 | 25 10 | 25 39 | 26 9 | 26 38 | 27 7 | 27 36 | 28 6 | 28 35 | 20 | 10 | 11 | 12 | 13 | 14 |
| 30 | 24 44 | 25 13 | 25 42 | 26 12 | 26 41 | 27 10 | 27 40 | 28 9 | 28 38 | 30 | 15 | 16 | 17 | 18 | 19 |
| 40 | 24 47 | 25 16 | 25 45 | 26 15 | 26 44 | 27 13 | 27 43 | 28 12 | 28 41 | 40 | 19 | 20 | 21 | 22 | 23 |
| 50 | 24 50 | 25 19 | 25 48 | 26 18 | 26 47 | 27 16 | 27 46 | 28 15 | 28 44 | 50 | 24 | 25 | 26 | 27 | 28 |
| 58 0 | 24 52 | 25 22 | 25 51 | 26 21 | 26 50 | 27 19 | 27 49 | 28 18 | 28 48 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 24 55 | 25 25 | 25 54 | 26 24 | 26 53 | 27 23 | 27 52 | 28 21 | 28 51 | 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 24 58 | 25 28 | 25 57 | 26 27 | 26 56 | 27 26 | 27 55 | 28 25 | 28 54 | 20 | 10 | 11 | 12 | 13 | 14 |
| 30 | 25 1 | 25 30 | 26 0 | 26 29 | 26 59 | 27 29 | 27 58 | 28 28 | 28 57 | 30 | 15 | 16 | 17 | 18 | 19 |
| 40 | 25 3 | 25 33 | 26 3 | 26 32 | 27 2 | 27 32 | 28 1 | 28 31 | 29 0 | 40 | 20 | 21 | 22 | 23 | 24 |
| 50 | 25 6 | 25 36 | 26 6 | 26 35 | 27 5 | 27 34 | 28 4 | 28 34 | 29 3 | 50 | 25 | 26 | 27 | 28 | 29 |
| 59 0 | 25 9 | 25 39 | 26 8 | 26 38 | 27 8 | 27 37 | 28 7 | 28 37 | 29 6 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 25 11 | 25 41 | 26 11 | 26 41 | 27 11 | 27 40 | 28 10 | 28 40 | 29 10 | 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 25 14 | 25 44 | 26 14 | 26 44 | 27 13 | 27 43 | 28 13 | 28 43 | 29 13 | 20 | 10 | 11 | 12 | 13 | 14 |
| 30 | 25 17 | 25 47 | 26 17 | 26 47 | 27 16 | 27 46 | 28 16 | 28 46 | 29 16 | 30 | 15 | 16 | 17 | 18 | 19 |
| 40 | 25 20 | 25 49 | 26 19 | 26 49 | 27 19 | 27 49 | 28 19 | 28 49 | 29 19 | 40 | 20 | 21 | 22 | 23 | 24 |
| 50 | 25 22 | 25 52 | 26 22 | 26 52 | 27 22 | 27 52 | 28 22 | 28 52 | 29 22 | 50 | 25 | 26 | 27 | 28 | 29 |

Add for Minutes of Moon's Alt. { 1′ 0″ | 2′ 1″ | 3′ 1″ | 4′ 1″ | 5′ 2″ | 6′ 2″ | 7′ 2″ | 8′ 3″ | 9′ 3″ }

Add for Alt. of Sun.

| ° | ′ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 80 | 5 |
| 90 | 5 |

Add for Alt. of Star.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 1 |
| 10 | 1 |
| 20 | 0 |
| 30 | 0 |
| 40 | 0 |
| 50 | 0 |
| 60 | 0 |
| 70 | 0 |
| 80 | 0 |
| 90 | 0 |

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ | Add for Minutes of Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ″ | ″ | ″ | ″ | |
| 60 0 | 25 47 | 26 17 | 26 47 | 27 17 | 27 47 | 28 17 | 28 47 | 29 17 | 29 47 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 25 39 | 26 9 | 26 39 | 27 9 | 27 39 | 28 9 | 28 38 | 29 8 | 29 38 | 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 25 31 | 26 1 | 26 31 | 27 1 | 27 30 | 28 0 | 28 30 | 28 59 | 29 29 | 20 | 10 | 11 | 12 | 13 | 14 |
| 30 | 25 23 | 25 53 | 26 23 | 26 52 | 27 22 | 27 51 | 28 21 | 28 51 | 29 20 | 30 | 15 | 16 | 17 | 18 | 19 |
| 40 | 25 16 | 25 45 | 26 15 | 26 44 | 27 13 | 27 43 | 28 12 | 28 42 | 29 11 | 40 | 20 | 21 | 22 | 23 | 24 |
| 50 | 25 8 | 25 37 | 26 6 | 26 36 | 27 5 | 27 34 | 28 3 | 28 33 | 29 2 | 50 | 25 | 26 | 27 | 28 | 29 |
| 61 0 | 25 0 | 25 29 | 25 58 | 26 27 | 26 56 | 27 26 | 27 55 | 28 24 | 28 53 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 24 52 | 25 21 | 25 50 | 26 19 | 26 48 | 27 17 | 27 46 | 28 15 | 28 44 | 10 | 5 | 6 | 7 | 8 | 9 |
| 20 | 24 44 | 25 13 | 25 42 | 26 11 | 26 39 | 27 8 | 27 37 | 28 6 | 28 35 | 20 | 10 | 10 | 11 | 12 | 13 |
| 30 | 24 37 | 25 5 | 25 34 | 26 2 | 26 31 | 27 0 | 27 28 | 27 57 | 28 25 | 30 | 14 | 15 | 16 | 17 | 18 |
| 40 | 24 29 | 24 57 | 25 25 | 25 54 | 26 22 | 26 51 | 27 19 | 27 48 | 28 16 | 40 | 19 | 20 | 21 | 22 | 23 |
| 50 | 24 21 | 24 49 | 25 17 | 25 46 | 26 14 | 26 42 | 27 11 | 27 39 | 28 7 | 50 | 24 | 25 | 26 | 27 | 28 |
| 62 0 | 24 13 | 24 41 | 25 9 | 25 37 | 26 5 | 26 33 | 27 2 | 27 30 | 27 58 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 24 5 | 24 33 | 25 1 | 25 29 | 25 57 | 26 25 | 26 53 | 27 21 | 27 49 | 10 | 5 | 6 | 6 | 7 | 8 |
| 20 | 23 57 | 24 25 | 24 52 | 25 20 | 25 48 | 26 16 | 26 44 | 27 12 | 27 40 | 20 | 9 | 10 | 11 | 12 | 13 |
| 30 | 23 49 | 24 16 | 24 44 | 25 12 | 25 40 | 26 7 | 26 35 | 27 3 | 27 30 | 30 | 14 | 15 | 16 | 17 | 18 |
| 40 | 23 41 | 24 8 | 24 36 | 25 3 | 25 31 | 25 58 | 26 26 | 26 54 | 27 21 | 40 | 18 | 19 | 20 | 21 | 22 |
| 50 | 23 33 | 24 0 | 24 28 | 24 55 | 25 22 | 25 50 | 26 17 | 26 44 | 27 12 | 50 | 23 | 24 | 25 | 26 | 27 |
| 63 0 | 23 25 | 23 52 | 24 19 | 24 46 | 25 14 | 25 41 | 26 8 | 26 35 | 27 3 | 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 23 17 | 23 44 | 24 11 | 24 38 | 25 5 | 25 32 | 25 59 | 26 26 | 26 53 | 10 | 4 | 5 | 6 | 7 | 8 |
| 20 | 23 8 | 23 35 | 24 2 | 24 29 | 24 56 | 25 23 | 25 50 | 26 17 | 26 44 | 20 | 9 | 10 | 11 | 12 | 12 |
| 30 | 23 0 | 23 27 | 23 54 | 24 21 | 24 48 | 25 14 | 25 41 | 26 8 | 26 35 | 30 | 13 | 14 | 15 | 16 | 17 |
| 40 | 22 52 | 23 19 | 23 46 | 24 12 | 24 39 | 25 5 | 25 32 | 25 59 | 26 25 | 40 | 18 | 19 | 20 | 21 | 21 |
| 50 | 22 44 | 23 11 | 23 37 | 24 4 | 24 30 | 24 57 | 25 23 | 25 50 | 26 16 | 50 | 22 | 23 | 24 | 25 | 26 |
| 64 0 | 22 36 | 23 3 | 23 29 | 23 55 | 24 21 | 24 48 | 25 14 | 25 40 | 26 7 | 0 | 0 | 1 | 2 | 3 | 3 |
| 10 | 22 28 | 22 54 | 23 20 | 23 47 | 24 13 | 24 39 | 25 5 | 25 31 | 25 57 | 10 | 4 | 5 | 6 | 7 | 8 |
| 20 | 22 19 | 22 46 | 23 12 | 23 38 | 24 4 | 24 30 | 24 56 | 25 22 | 25 48 | 20 | 9 | 9 | 10 | 11 | 12 |
| 30 | 22 11 | 22 38 | 23 4 | 23 29 | 23 55 | 24 21 | 24 47 | 25 13 | 25 38 | 30 | 13 | 14 | 15 | 15 | 16 |
| 40 | 22 3 | 22 29 | 22 55 | 23 21 | 23 46 | 24 12 | 24 38 | 25 3 | 25 29 | 40 | 17 | 18 | 19 | 20 | 21 |
| 50 | 21 55 | 22 21 | 22 47 | 23 12 | 23 38 | 24 3 | 24 29 | 24 54 | 25 20 | 50 | 22 | 22 | 23 | 24 | 25 |
| 65 0 | 21 47 | 22 13 | 22 38 | 23 3 | 23 29 | 23 54 | 24 20 | 24 45 | 25 10 | 0 | 0 | 1 | 2 | 2 | 3 |
| 10 | 21 39 | 22 4 | 22 30 | 22 55 | 23 20 | 23 45 | 24 10 | 24 36 | 25 1 | 10 | 4 | 5 | 6 | 7 | 7 |
| 20 | 21 31 | 21 56 | 22 21 | 22 46 | 23 11 | 23 36 | 24 1 | 24 26 | 24 51 | 20 | 8 | 9 | 10 | 11 | 12 |
| 30 | 21 23 | 21 48 | 22 13 | 22 37 | 23 2 | 23 27 | 23 52 | 24 17 | 24 42 | 30 | 12 | 13 | 14 | 15 | 16 |
| 40 | 21 15 | 21 39 | 22 4 | 22 29 | 22 53 | 23 18 | 23 43 | 24 8 | 24 33 | 40 | 17 | 17 | 18 | 19 | 20 |
| 50 | 21 7 | 21 31 | 21 55 | 22 20 | 22 45 | 23 9 | 23 34 | 23 58 | 24 23 | 50 | 21 | 21 | 22 | 23 | 24 |
| 66 0 | 20 59 | 21 22 | 21 47 | 22 11 | 22 36 | 23 0 | 23 24 | 23 49 | 24 13 | 0 | 0 | 1 | 2 | 2 | 3 |
| 10 | 20 50 | 21 14 | 21 38 | 22 3 | 22 27 | 22 51 | 23 15 | 23 40 | 24 4 | 10 | 4 | 5 | 6 | 6 | 7 |
| 20 | 20 41 | 21 6 | 21 30 | 21 54 | 22 18 | 22 42 | 23 6 | 23 30 | 23 54 | 20 | 8 | 9 | 10 | 10 | 11 |
| 30 | 20 33 | 20 57 | 21 21 | 21 45 | 22 9 | 22 33 | 22 57 | 23 21 | 23 45 | 30 | 12 | 13 | 14 | 14 | 15 |
| 40 | 20 25 | 20 49 | 21 13 | 21 36 | 22 0 | 22 24 | 22 48 | 23 11 | 23 35 | 40 | 16 | 17 | 18 | 18 | 19 |
| 50 | 20 17 | 20 40 | 21 4 | 21 27 | 21 51 | 22 15 | 22 38 | 23 2 | 23 25 | 50 | 20 | 21 | 21 | 22 | 23 |
| 67 0 | 20 9 | 20 32 | 20 55 | 21 19 | 21 42 | 22 6 | 22 29 | 22 52 | 23 16 | 0 | 0 | 1 | 2 | 2 | 3 |
| 10 | 20 0 | 20 23 | 20 47 | 21 10 | 21 33 | 21 56 | 22 20 | 22 43 | 23 6 | 10 | 4 | 5 | 5 | 6 | 7 |
| 20 | 19 51 | 20 15 | 20 38 | 21 1 | 21 24 | 21 47 | 22 10 | 22 34 | 22 57 | 20 | 8 | 8 | 9 | 10 | 11 |
| 30 | 19 43 | 20 6 | 20 29 | 20 52 | 21 15 | 21 38 | 22 1 | 22 24 | 22 47 | 30 | 11 | 12 | 13 | 14 | 14 |
| 40 | 19 35 | 19 58 | 20 21 | 20 43 | 21 6 | 21 29 | 21 52 | 22 15 | 22 37 | 40 | 15 | 16 | 17 | 18 | 18 |
| 50 | 19 27 | 19 49 | 20 12 | 20 35 | 20 57 | 21 20 | 21 42 | 22 5 | 22 28 | 50 | 19 | 20 | 21 | 21 | 22 |
| 68 0 | 19 18 | 19 41 | 20 3 | 20 26 | 20 48 | 21 11 | 21 33 | 21 56 | 22 18 | 0 | 0 | 1 | 2 | 2 | 3 |
| 10 | 19 10 | 19 32 | 19 54 | 20 17 | 20 39 | 21 1 | 21 24 | 21 46 | 22 8 | 10 | 4 | 4 | 5 | 6 | 7 |
| 20 | 19 1 | 19 24 | 19 46 | 20 8 | 20 30 | 20 52 | 21 14 | 21 37 | 21 59 | 20 | 7 | 8 | 9 | 10 | 10 |
| 30 | 18 53 | 19 15 | 19 37 | 19 59 | 20 21 | 20 43 | 21 5 | 21 27 | 21 49 | 30 | 11 | 12 | 12 | 13 | 14 |
| 40 | 18 45 | 19 6 | 19 28 | 19 50 | 20 12 | 20 34 | 20 56 | 21 17 | 21 39 | 40 | 15 | 15 | 16 | 17 | 18 |
| 50 | 18 36 | 18 58 | 19 20 | 19 41 | 20 3 | 20 25 | 20 46 | 21 8 | 21 29 | 50 | 18 | 19 | 20 | 20 | 21 |
| 69 0 | 18 28 | 18 49 | 19 11 | 19 32 | 19 54 | 20 15 | 20 37 | 20 58 | 21 20 | 0 | 0 | 1 | 1 | 2 | 3 |
| 10 | 18 19 | 18 41 | 19 2 | 19 23 | 19 45 | 20 6 | 20 27 | 20 48 | 21 10 | 10 | 4 | 4 | 5 | 6 | 6 |
| 20 | 18 10 | 18 32 | 18 53 | 19 14 | 19 36 | 19 57 | 20 18 | 20 39 | 21 0 | 20 | 7 | 8 | 8 | 9 | 10 |
| 30 | 18 2 | 18 23 | 18 44 | 19 5 | 19 26 | 19 47 | 20 8 | 20 29 | 20 50 | 30 | 11 | 11 | 12 | 13 | 13 |
| 40 | 17 54 | 18 15 | 18 36 | 18 56 | 19 17 | 19 38 | 19 59 | 20 20 | 20 41 | 40 | 14 | 15 | 15 | 16 | 17 |
| 50 | 17 45 | 18 6 | 18 27 | 18 47 | 19 8 | 19 29 | 19 49 | 20 10 | 20 31 | 50 | 18 | 18 | 19 | 20 | 20 |

| Add for Minutes of Alt. | |
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| ′ | ″ |
| 0 | 10 |
| 1 | 9 |
| 2 | 8 |
| 3 | 7 |
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| 9 | 2 |
| 0 | 10 |
| 1 | 9 |
| 2 | 8 |
| 3 | 7 |
| 4 | 7 |
| 5 | 6 |
| 6 | 5 |
| 7 | 4 |
| 8 | 3 |
| 9 | 2 |
| 0 | 10 |
| 1 | 9 |
| 2 | 8 |
| 3 | 7 |
| 4 | 7 |
| 5 | 6 |
| 6 | 5 |
| 7 | 4 |
| 8 | 3 |
| 9 | 2 |
| 0 | 10 |
| 1 | 9 |
| 2 | 8 |
| 3 | 7 |
| 4 | 6 |
| 5 | 6 |
| 6 | 5 |
| 7 | 4 |
| 8 | 3 |
| 9 | 2 |
| 0 | 10 |
| 1 | 9 |
| 2 | 8 |
| 3 | 7 |
| 4 | 6 |
| 5 | 5 |
| 6 | 5 |
| 7 | 4 |
| 8 | 3 |
| 9 | 2 |

# TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 60 0 | 25 25 | 25 55 | 26 25 | 26 55 | 27 25 | 27 55 | 28 25 | 28 55 | 29 25 |
| 10 | 25 27 | 25 57 | 26 28 | 26 58 | 27 28 | 27 58 | 28 28 | 28 58 | 29 28 |
| 20 | 25 30 | 26 0 | 26 30 | 27 1 | 27 31 | 28 1 | 28 31 | 29 1 | 29 31 |
| 30 | 25 33 | 26 3 | 26 33 | 27 3 | 27 33 | 28 4 | 28 34 | 29 4 | 29 34 |
| 40 | 25 35 | 26 5 | 26 36 | 27 6 | 27 36 | 28 6 | 28 37 | 29 7 | 29 37 |
| 50 | 25 38 | 26 8 | 26 38 | 27 9 | 27 39 | 28 9 | 28 39 | 29 10 | 29 40 |
| 61 0 | 25 40 | 26 11 | 26 41 | 27 11 | 27 42 | 28 12 | 28 42 | 29 12 | 29 43 |
| 10 | 25 43 | 26 13 | 26 44 | 27 14 | 27 44 | 28 15 | 28 45 | 29 15 | 29 46 |
| 20 | 25 45 | 26 16 | 26 46 | 27 17 | 27 47 | 28 18 | 28 48 | 29 18 | 29 49 |
| 30 | 25 48 | 26 18 | 26 49 | 27 19 | 27 50 | 28 20 | 28 51 | 29 21 | 29 52 |
| 40 | 25 51 | 26 21 | 26 51 | 27 22 | 27 52 | 28 23 | 28 53 | 29 24 | 29 54 |
| 50 | 25 53 | 26 23 | 26 54 | 27 25 | 27 55 | 28 26 | 28 56 | 29 27 | 29 57 |
| 62 0 | 25 55 | 26 26 | 26 57 | 27 27 | 27 58 | 28 28 | 28 59 | 29 29 | 30 0 |
| 10 | 25 58 | 26 28 | 26 59 | 27 30 | 28 0 | 28 31 | 29 2 | 29 32 | 30 3 |
| 20 | 26 0 | 26 31 | 27 2 | 27 32 | 28 3 | 28 34 | 29 4 | 29 35 | 30 6 |
| 30 | 26 3 | 26 33 | 27 4 | 27 35 | 28 6 | 28 36 | 29 7 | 29 38 | 30 8 |
| 40 | 26 5 | 26 36 | 27 7 | 27 37 | 28 8 | 28 39 | 29 10 | 29 40 | 30 11 |
| 50 | 26 7 | 26 38 | 27 9 | 27 40 | 28 11 | 28 42 | 29 12 | 29 43 | 30 14 |
| 63 0 | 26 10 | 26 41 | 27 12 | 27 43 | 28 13 | 28 44 | 29 15 | 29 46 | 30 17 |
| 10 | 26 12 | 26 43 | 27 14 | 27 45 | 28 16 | 28 47 | 29 18 | 29 49 | 30 19 |
| 20 | 26 15 | 26 46 | 27 17 | 27 48 | 28 19 | 28 50 | 29 20 | 29 51 | 30 22 |
| 30 | 26 17 | 26 48 | 27 19 | 27 50 | 28 21 | 28 52 | 29 23 | 29 54 | 30 25 |
| 40 | 26 19 | 26 50 | 27 21 | 27 52 | 28 23 | 28 54 | 29 25 | 29 56 | 30 27 |
| 50 | 26 22 | 26 53 | 27 24 | 27 55 | 28 26 | 28 57 | 29 28 | 29 59 | 30 30 |
| 64 0 | 26 24 | 26 55 | 27 26 | 27 57 | 28 28 | 28 59 | 29 31 | 30 2 | 30 33 |
| 10 | 26 26 | 26 57 | 27 29 | 28 0 | 28 31 | 29 2 | 29 33 | 30 4 | 30 35 |
| 20 | 26 28 | 27 0 | 27 31 | 28 2 | 28 33 | 29 5 | 29 36 | 30 7 | 30 38 |
| 30 | 26 31 | 27 2 | 27 33 | 28 5 | 28 36 | 29 7 | 29 38 | 30 9 | 30 41 |
| 40 | 26 33 | 27 4 | 27 36 | 28 7 | 28 38 | 29 9 | 29 41 | 30 12 | 30 43 |
| 50 | 26 35 | 27 7 | 27 38 | 28 9 | 28 41 | 29 12 | 29 43 | 30 14 | 30 46 |
| 65 0 | 26 37 | 27 9 | 27 40 | 28 12 | 28 43 | 29 14 | 29 46 | 30 17 | 30 48 |
| 10 | 26 40 | 27 11 | 27 43 | 28 14 | 28 45 | 29 17 | 29 48 | 30 20 | 30 51 |
| 20 | 26 42 | 27 13 | 27 45 | 28 16 | 28 48 | 29 19 | 29 51 | 30 22 | 30 53 |
| 30 | 26 44 | 27 16 | 27 47 | 28 19 | 28 50 | 29 22 | 29 53 | 30 24 | 30 56 |
| 40 | 26 46 | 27 18 | 27 49 | 28 21 | 28 52 | 29 24 | 29 55 | 30 27 | 30 58 |
| 50 | 26 48 | 27 20 | 27 52 | 28 23 | 28 55 | 29 26 | 29 58 | 30 29 | 31 1 |
| 66 0 | 26 51 | 27 22 | 27 54 | 28 25 | 28 57 | 29 29 | 30 0 | 30 32 | 31 3 |
| 10 | 26 53 | 27 24 | 27 56 | 28 28 | 28 59 | 29 31 | 30 3 | 30 34 | 31 6 |
| 20 | 26 55 | 27 27 | 27 58 | 28 30 | 29 2 | 29 33 | 30 5 | 30 36 | 31 8 |
| 30 | 26 57 | 27 29 | 28 0 | 28 32 | 29 4 | 29 35 | 30 7 | 30 39 | 31 11 |
| 40 | 26 59 | 27 31 | 28 2 | 28 34 | 29 6 | 29 38 | 30 10 | 30 41 | 31 13 |
| 50 | 27 1 | 27 33 | 28 5 | 28 37 | 29 8 | 29 40 | 30 12 | 30 44 | 31 16 |
| 67 0 | 27 3 | 27 35 | 28 7 | 28 39 | 29 10 | 29 42 | 30 14 | 30 46 | 31 18 |
| 10 | 27 5 | 27 37 | 28 9 | 28 41 | 29 13 | 29 45 | 30 16 | 30 48 | 31 20 |
| 20 | 27 7 | 27 39 | 28 11 | 28 43 | 29 15 | 29 47 | 30 19 | 30 50 | 31 22 |
| 30 | 27 9 | 27 41 | 28 13 | 28 45 | 29 17 | 29 49 | 30 21 | 30 53 | 31 25 |
| 40 | 27 11 | 27 43 | 28 15 | 28 47 | 29 19 | 29 51 | 30 23 | 30 55 | 31 27 |
| 50 | 27 13 | 27 45 | 28 17 | 28 49 | 29 21 | 29 53 | 30 25 | 30 57 | 31 29 |
| 68 0 | 27 15 | 27 47 | 28 19 | 28 51 | 29 23 | 29 55 | 30 28 | 31 0 | 31 32 |
| 10 | 27 17 | 27 49 | 28 21 | 28 53 | 29 26 | 29 58 | 30 30 | 31 2 | 31 34 |
| 20 | 27 19 | 27 51 | 28 23 | 28 55 | 29 28 | 30 0 | 30 32 | 31 4 | 31 36 |
| 30 | 27 21 | 27 53 | 28 25 | 28 57 | 29 30 | 30 2 | 30 34 | 31 6 | 31 38 |
| 40 | 27 23 | 27 55 | 28 27 | 28 59 | 29 32 | 30 4 | 30 36 | 31 8 | 31 40 |
| 50 | 27 25 | 27 57 | 28 29 | 29 2 | 29 34 | 30 6 | 30 38 | 31 11 | 31 43 |
| 69 0 | 27 27 | 27 59 | 28 31 | 29 4 | 29 36 | 30 8 | 30 40 | 31 13 | 31 45 |
| 10 | 27 29 | 28 1 | 28 33 | 29 6 | 29 38 | 30 10 | 30 42 | 31 15 | 31 47 |
| 20 | 27 30 | 28 3 | 28 35 | 29 8 | 29 40 | 30 12 | 30 45 | 31 17 | 31 49 |
| 30 | 27 32 | 28 5 | 28 37 | 29 9 | 29 42 | 30 14 | 30 47 | 31 19 | 31 51 |
| 40 | 27 34 | 28 6 | 28 39 | 29 11 | 29 44 | 30 16 | 30 49 | 31 21 | 31 53 |
| 50 | 27 36 | 28 8 | 28 41 | 29 13 | 29 46 | 30 18 | 30 51 | 31 23 | 31 55 |

Add for Sec. of Par.

| 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|
| ″ | ″ | ″ | ″ | ″ |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 |

Add for Alt. of SUN.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
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| 6 | 3 |
| 7 | 2 |
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| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 80 | 5 |
| 90 | 5 |

Add for Alt. of STAR.

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| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 1 |
| 10 | 1 |
| 20 | 0 |
| 30 | 0 |
| 40 | 0 |
| 50 | 0 |
| 60 | 0 |
| 70 | 0 |
| 80 | 0 |
| 90 | 0 |

Add for Minutes of Moon's Alt. { 1′ 2′ 3′ 4′ 5′ 6′ 7′ 8′ 9′ / 0″ 0″ 1″ 1″ 1″ 1″ 2″ 2″ 2″

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽ App. Alt. | | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ | Add for Minutes of Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ″ | ″ | ″ | ″ | ′ ″ |
| 70 | 0 | 17 37 | 17 57 | 18 18 | 18 38 | 18 59 | 19 20 | 19 40 | 20 1 | 20 21 | 0 | 0 | 1 | 1 | 2 | 3 | 0 10 |
| | 10 | 17 28 | 17 49 | 18 9 | 18 29 | 18 50 | 19 10 | 19 31 | 19 51 | 20 11 | 10 | 3 | 4 | 5 | 5 | 6 | 1 9 |
| | 20 | 17 19 | 17 40 | 18 0 | 18 20 | 18 41 | 19 1 | 19 21 | 19 41 | 20 1 | 20 | 7 | 7 | 8 | 9 | 9 | 2 8 |
| | 30 | 17 11 | 17 31 | 17 51 | 18 11 | 18 31 | 18 51 | 19 12 | 19 32 | 19 52 | 30 | 10 | 11 | 11 | 12 | 13 | 3 7 |
| | 40 | 17 3 | 17 23 | 17 43 | 18 2 | 18 22 | 18 42 | 19 2 | 19 22 | 19 42 | 40 | 13 | 14 | 15 | 15 | 16 | 4 6 |
| | 50 | 16 55 | 17 14 | 17 34 | 17 53 | 18 13 | 18 33 | 18 52 | 19 12 | 19 32 | 50 | 17 | 17 | 18 | 19 | 19 | 5 5 |
| 71 | 0 | 16 46 | 17 5 | 17 25 | 17 44 | 18 4 | 18 23 | 18 43 | 19 2 | 19 22 | 0 | 0 | 1 | 1 | 2 | 3 | 6 4 |
| | 10 | 16 37 | 16 56 | 17 16 | 17 35 | 17 55 | 18 14 | 18 33 | 18 53 | 19 12 | 10 | 3 | 4 | 4 | 5 | 6 | 7 4 |
| | 20 | 16 29 | 16 48 | 17 7 | 17 26 | 17 45 | 18 5 | 18 24 | 18 43 | 19 2 | 20 | 6 | 7 | 8 | 8 | 9 | 8 3 |
| | 30 | 16 20 | 16 39 | 16 58 | 17 17 | 17 36 | 17 55 | 18 14 | 18 33 | 18 52 | 30 | 10 | 10 | 11 | 11 | 12 | 9 2 |
| | 40 | 16 12 | 16 30 | 16 49 | 17 8 | 17 27 | 17 46 | 18 5 | 18 23 | 18 42 | 40 | 13 | 13 | 14 | 15 | 15 | |
| | 50 | 16 3 | 16 21 | 16 40 | 16 59 | 17 18 | 17 36 | 17 55 | 18 14 | 18 32 | 50 | 16 | 16 | 17 | 18 | 18 | |
| 72 | 0 | 15 54 | 16 13 | 16 31 | 16 50 | 17 8 | 17 27 | 17 45 | 18 4 | 18 22 | 0 | 0 | 1 | 1 | 2 | 2 | |
| | 10 | 15 46 | 16 4 | 16 22 | 16 41 | 16 59 | 17 17 | 17 36 | 17 54 | 18 13 | 10 | 3 | 4 | 4 | 5 | 5 | ′ ″ |
| | 20 | 15 37 | 15 55 | 16 13 | 16 32 | 16 50 | 17 8 | 17 26 | 17 44 | 18 3 | 20 | 6 | 7 | 7 | 8 | 8 | 0 10 |
| | 30 | 15 28 | 15 46 | 16 4 | 16 22 | 16 40 | 16 59 | 17 17 | 17 35 | 17 53 | 30 | 9 | 10 | 10 | 11 | 11 | 1 9 |
| | 40 | 15 20 | 15 38 | 15 55 | 16 13 | 16 31 | 16 49 | 17 7 | 17 25 | 17 43 | 40 | 12 | 13 | 13 | 14 | 14 | 2 8 |
| | 50 | 15 12 | 15 29 | 15 46 | 16 4 | 16 22 | 16 40 | 16 57 | 17 15 | 17 33 | 50 | 15 | 16 | 16 | 17 | 17 | 3 7 |
| 73 | 0 | 15 3 | 15 20 | 15 37 | 15 55 | 16 12 | 16 30 | 16 48 | 17 5 | 17 23 | 0 | 0 | 1 | 1 | 2 | 2 | 4 6 |
| | 10 | 14 54 | 15 11 | 15 28 | 15 46 | 16 3 | 16 21 | 16 38 | 16 55 | 17 13 | 10 | 3 | 3 | 4 | 5 | 5 | 5 5 |
| | 20 | 14 45 | 15 2 | 15 19 | 15 37 | 15 54 | 16 11 | 16 28 | 16 45 | 17 3 | 20 | 6 | 6 | 7 | 7 | 8 | 6 4 |
| | 30 | 14 36 | 14 53 | 15 10 | 15 27 | 15 44 | 16 2 | 16 19 | 16 36 | 16 53 | 30 | 9 | 9 | 10 | 10 | 11 | 7 4 |
| | 40 | 14 28 | 14 44 | 15 1 | 15 18 | 15 35 | 15 52 | 16 9 | 16 26 | 16 43 | 40 | 11 | 12 | 12 | 13 | 14 | 8 3 |
| | 50 | 14 19 | 14 36 | 14 52 | 15 9 | 15 26 | 15 42 | 15 59 | 16 16 | 16 33 | 50 | 14 | 15 | 15 | 16 | 16 | 9 2 |
| 74 | 0 | 14 11 | 14 27 | 14 43 | 15 0 | 15 16 | 15 33 | 15 49 | 16 6 | 16 23 | 0 | 0 | 1 | 1 | 2 | 2 | |
| | 10 | 14 2 | 14 18 | 14 34 | 14 51 | 15 7 | 15 23 | 15 40 | 15 56 | 16 12 | 10 | 3 | 3 | 4 | 4 | 5 | ′ ″ |
| | 20 | 13 53 | 14 9 | 14 25 | 14 41 | 14 58 | 15 14 | 15 30 | 15 46 | 16 2 | 20 | 5 | 6 | 6 | 7 | 7 | 0 10 |
| | 30 | 13 44 | 14 0 | 14 16 | 14 32 | 14 48 | 15 4 | 15 20 | 15 36 | 15 52 | 30 | 8 | 9 | 9 | 10 | 10 | 1 9 |
| | 40 | 13 36 | 13 51 | 14 7 | 14 23 | 14 39 | 14 55 | 15 10 | 15 26 | 15 42 | 40 | 11 | 11 | 12 | 12 | 13 | 2 8 |
| | 50 | 13 27 | 13 42 | 13 58 | 14 14 | 14 29 | 14 45 | 15 1 | 15 16 | 15 32 | 50 | 13 | 14 | 14 | 15 | 15 | 3 7 |
| 75 | 0 | 13 18 | 13 33 | 13 49 | 14 4 | 14 20 | 14 35 | 14 51 | 15 6 | 15 22 | 0 | 0 | 1 | 1 | 2 | 2 | 4 6 |
| | 10 | 13 9 | 13 24 | 13 40 | 13 55 | 14 10 | 14 26 | 14 41 | 14 57 | 15 12 | 10 | 3 | 3 | 4 | 4 | 5 | 5 5 |
| | 20 | 13 0 | 13 15 | 13 31 | 13 46 | 14 1 | 14 16 | 14 31 | 14 47 | 15 2 | 20 | 5 | 6 | 6 | 7 | 7 | 6 4 |
| | 30 | 12 51 | 13 6 | 13 22 | 13 37 | 13 52 | 14 7 | 14 22 | 14 37 | 14 52 | 30 | 8 | 8 | 9 | 9 | 10 | 7 3 |
| | 40 | 12 42 | 12 58 | 13 12 | 13 27 | 13 42 | 13 57 | 14 12 | 14 27 | 14 42 | 40 | 10 | 11 | 11 | 12 | 12 | 8 2 |
| | 50 | 12 33 | 12 49 | 13 3 | 13 18 | 13 33 | 13 47 | 14 2 | 14 17 | 14 31 | 50 | 13 | 13 | 14 | 14 | 15 | 9 2 |
| 76 | 0 | 12 25 | 12 40 | 12 54 | 13 9 | 13 23 | 13 38 | 13 52 | 14 7 | 14 21 | 0 | 0 | 0 | 1 | 1 | 2 | |
| | 10 | 12 16 | 12 31 | 12 45 | 12 59 | 13 14 | 13 28 | 13 42 | 13 57 | 14 11 | 10 | 2 | 3 | 3 | 4 | 4 | ′ ″ |
| | 20 | 12 7 | 12 22 | 12 36 | 12 50 | 13 4 | 13 18 | 13 33 | 13 47 | 14 1 | 20 | 5 | 5 | 6 | 6 | 7 | 0 10 |
| | 30 | 11 58 | 12 13 | 12 27 | 12 41 | 12 55 | 13 9 | 13 23 | 13 37 | 13 51 | 30 | 7 | 7 | 8 | 8 | 9 | 1 9 |
| | 40 | 11 49 | 12 4 | 12 18 | 12 31 | 12 45 | 12 59 | 13 13 | 13 27 | 13 41 | 40 | 9 | 10 | 10 | 11 | 11 | 2 8 |
| | 50 | 11 41 | 11 55 | 12 8 | 12 22 | 12 36 | 12 49 | 13 3 | 13 17 | 13 30 | 50 | 12 | 12 | 13 | 13 | 14 | 3 7 |
| 77 | 0 | 11 32 | 11 46 | 11 59 | 12 13 | 12 26 | 12 40 | 12 53 | 13 7 | 13 20 | 0 | 0 | 0 | 1 | 1 | 2 | 4 6 |
| | 10 | 11 23 | 11 37 | 11 50 | 12 3 | 12 17 | 12 30 | 12 43 | 12 57 | 13 10 | 10 | 2 | 3 | 3 | 4 | 4 | 5 5 |
| | 20 | 11 14 | 11 28 | 11 41 | 11 54 | 12 7 | 12 20 | 12 33 | 12 47 | 13 0 | 20 | 4 | 5 | 5 | 6 | 6 | 6 4 |
| | 30 | 11 5 | 11 19 | 11 32 | 11 45 | 11 57 | 12 11 | 12 24 | 12 37 | 12 50 | 30 | 7 | 7 | 7 | 8 | 8 | 7 3 |
| | 40 | 10 56 | 11 10 | 11 22 | 11 35 | 11 48 | 12 1 | 12 14 | 12 27 | 12 39 | 40 | 9 | 9 | 10 | 10 | 10 | 8 2 |
| | 50 | 10 48 | 11 1 | 11 13 | 11 26 | 11 39 | 11 51 | 12 4 | 12 16 | 12 29 | 50 | 11 | 11 | 12 | 12 | 13 | 9 1 |
| 78 | 0 | 10 39 | 10 52 | 11 4 | 11 16 | 11 29 | 11 41 | 11 54 | 12 6 | 12 19 | 0 | 0 | 0 | 1 | 1 | 2 | |
| | 10 | 10 30 | 10 42 | 10 55 | 11 7 | 11 19 | 11 32 | 11 44 | 11 56 | 12 9 | 10 | 2 | 2 | 3 | 3 | 4 | ′ ″ |
| | 20 | 10 21 | 10 33 | 10 46 | 10 58 | 11 10 | 11 22 | 11 34 | 11 46 | 11 58 | 20 | 4 | 4 | 5 | 5 | 6 | 0 10 |
| | 30 | 10 12 | 10 24 | 10 36 | 10 48 | 11 0 | 11 12 | 11 24 | 11 36 | 11 48 | 30 | 6 | 6 | 7 | 7 | 8 | 1 9 |
| | 40 | 10 4 | 10 15 | 10 27 | 10 39 | 10 51 | 11 2 | 11 14 | 11 26 | 11 38 | 40 | 8 | 8 | 9 | 9 | 10 | 2 8 |
| | 50 | 9 55 | 10 6 | 10 18 | 10 29 | 10 41 | 10 53 | 11 4 | 11 16 | 11 28 | 50 | 10 | 10 | 11 | 11 | 12 | 3 7 |
| 79 | 0 | 9 46 | 9 57 | 10 9 | 10 20 | 10 31 | 10 43 | 10 54 | 11 6 | 11 17 | 0 | 0 | 0 | 1 | 1 | 1 | 4 6 |
| | 10 | 9 37 | 9 48 | 9 59 | 10 11 | 10 22 | 10 33 | 10 44 | 10 56 | 11 7 | 10 | 2 | 2 | 3 | 3 | 3 | 5 5 |
| | 20 | 9 28 | 9 39 | 9 50 | 10 1 | 10 12 | 10 23 | 10 34 | 10 46 | 10 57 | 20 | 4 | 4 | 4 | 5 | 5 | 6 4 |
| | 30 | 9 19 | 9 30 | 9 41 | 9 52 | 10 3 | 10 14 | 10 25 | 10 36 | 10 47 | 30 | 5 | 6 | 6 | 7 | 7 | 7 3 |
| | 40 | 9 10 | 9 21 | 9 32 | 9 42 | 9 53 | 10 4 | 10 15 | 10 25 | 10 36 | 40 | 7 | 8 | 8 | 8 | 9 | 8 2 |
| | 50 | 9 1 | 9 12 | 9 22 | 9 33 | 9 43 | 9 54 | 10 5 | 10 15 | 10 26 | 50 | 9 | 9 | 10 | 10 | 11 | 9 1 |

# TABLE XXX.*

**Auxiliary Arcs.**—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 70 0 | 27 38 | 28 10 | 28 43 | 29 15 | 29 48 | 30 20 | 30 53 | 31 25 | 31 57 |
| 10 | 27 40 | 28 12 | 28 45 | 29 17 | 29 50 | 30 22 | 30 55 | 31 27 | 31 59 |
| 20 | 27 41 | 28 14 | 28 46 | 29 19 | 29 52 | 30 24 | 30 57 | 31 29 | 32 1 |
| 30 | 27 43 | 28 16 | 28 48 | 29 21 | 29 54 | 30 26 | 30 59 | 31 31 | 32 3 |
| 40 | 27 45 | 28 18 | 28 50 | 29 23 | 29 55 | 30 28 | 31 0 | 31 33 | 32 5 |
| 50 | 27 47 | 28 19 | 28 52 | 29 24 | 29 57 | 30 30 | 31 2 | 31 35 | 32 7 |
| 71 0 | 27 48 | 28 21 | 28 54 | 29 26 | 29 59 | 30 32 | 31 4 | 31 37 | 32 9 |
| 10 | 27 50 | 28 23 | 28 55 | 29 28 | 30 1 | 30 34 | 31 6 | 31 39 | 32 11 |
| 20 | 27 52 | 28 24 | 28 57 | 29 30 | 30 3 | 30 35 | 31 8 | 31 41 | 32 13 |
| 30 | 27 53 | 28 26 | 28 59 | 29 32 | 30 4 | 30 37 | 31 10 | 31 43 | 32 15 |
| 40 | 27 55 | 28 28 | 29 1 | 29 33 | 30 6 | 30 39 | 31 12 | 31 44 | 32 17 |
| 50 | 27 57 | 28 29 | 29 2 | 29 35 | 30 8 | 30 41 | 31 14 | 31 46 | 32 19 |
| 72 0 | 27 58 | 28 31 | 29 4 | 29 37 | 30 10 | 30 42 | 31 15 | 31 48 | 32 21 |
| 10 | 28 0 | 28 33 | 29 6 | 29 38 | 30 11 | 30 44 | 31 17 | 31 50 | 32 23 |
| 20 | 28 1 | 28 34 | 29 7 | 29 40 | 30 13 | 30 46 | 31 19 | 31 52 | 32 25 |
| 30 | 28 3 | 28 36 | 29 9 | 29 42 | 30 15 | 30 48 | 31 21 | 31 54 | 32 27 |
| 40 | 28 5 | 28 37 | 29 11 | 29 44 | 30 17 | 30 49 | 31 22 | 31 55 | 32 28 |
| 50 | 28 6 | 28 39 | 29 12 | 29 45 | 30 18 | 30 51 | 31 24 | 31 57 | 32 30 |
| 73 0 | 28 8 | 28 41 | 29 14 | 29 47 | 30 20 | 30 53 | 31 26 | 31 59 | 32 32 |
| 10 | 28 9 | 28 42 | 29 15 | 29 48 | 30 21 | 30 54 | 31 27 | 32 0 | 32 34 |
| 20 | 28 11 | 28 44 | 29 17 | 29 50 | 30 23 | 30 56 | 31 29 | 32 2 | 32 35 |
| 30 | 28 12 | 28 45 | 29 19 | 29 52 | 30 25 | 30 58 | 31 31 | 32 4 | 32 37 |
| 40 | 28 14 | 28 47 | 29 20 | 29 53 | 30 26 | 30 59 | 31 33 | 32 6 | 32 39 |
| 50 | 28 15 | 28 48 | 29 22 | 29 55 | 30 28 | 31 1 | 31 34 | 32 7 | 32 40 |
| 74 0 | 28 16 | 28 50 | 29 23 | 29 56 | 30 30 | 31 3 | 31 36 | 32 9 | 32 42 |
| 10 | 28 18 | 28 51 | 29 24 | 29 58 | 30 31 | 31 4 | 31 37 | 32 10 | 32 44 |
| 20 | 28 19 | 28 53 | 29 26 | 29 59 | 30 32 | 31 6 | 31 39 | 32 12 | 32 45 |
| 30 | 28 21 | 28 54 | 29 27 | 30 1 | 30 34 | 31 7 | 31 40 | 32 14 | 32 47 |
| 40 | 28 22 | 28 55 | 29 29 | 30 2 | 30 35 | 31 9 | 31 42 | 32 15 | 32 49 |
| 50 | 28 24 | 28 57 | 29 30 | 30 4 | 30 37 | 31 10 | 31 44 | 32 17 | 32 50 |
| 75 0 | 28 25 | 28 58 | 29 32 | 30 5 | 30 38 | 31 12 | 31 45 | 32 18 | 32 52 |
| 10 | 28 26 | 29 0 | 29 33 | 30 6 | 30 40 | 31 13 | 31 47 | 32 20 | 32 53 |
| 20 | 28 28 | 29 1 | 29 34 | 30 8 | 30 42 | 31 15 | 31 48 | 32 21 | 32 55 |
| 30 | 28 29 | 29 2 | 29 36 | 30 9 | 30 43 | 31 16 | 31 50 | 32 23 | 32 56 |
| 40 | 28 30 | 29 4 | 29 37 | 30 11 | 30 44 | 31 18 | 31 51 | 32 24 | 32 58 |
| 50 | 28 32 | 29 5 | 29 38 | 30 12 | 30 46 | 31 19 | 31 52 | 32 26 | 32 59 |
| 76 0 | 28 33 | 29 6 | 29 40 | 30 13 | 30 47 | 31 20 | 31 54 | 32 27 | 33 1 |
| 10 | 28 34 | 29 8 | 29 41 | 30 15 | 30 48 | 31 22 | 31 55 | 32 29 | 33 2 |
| 20 | 28 35 | 29 9 | 29 42 | 30 16 | 30 50 | 31 23 | 31 56 | 32 30 | 33 3 |
| 30 | 28 37 | 29 10 | 29 44 | 30 17 | 30 51 | 31 25 | 31 58 | 32 32 | 33 5 |
| 40 | 28 38 | 29 11 | 29 45 | 30 18 | 30 52 | 31 26 | 31 59 | 32 33 | 33 7 |
| 50 | 28 39 | 29 13 | 29 46 | 30 20 | 30 53 | 31 27 | 32 1 | 32 34 | 33 8 |
| 77 0 | 28 40 | 29 14 | 29 48 | 30 21 | 30 55 | 31 28 | 32 2 | 32 36 | 33 9 |
| 10 | 28 41 | 29 15 | 29 49 | 30 23 | 30 56 | 31 30 | 32 3 | 32 37 | 33 11 |
| 20 | 28 43 | 29 16 | 29 50 | 30 24 | 30 57 | 31 31 | 32 5 | 32 38 | 33 12 |
| 30 | 28 44 | 29 17 | 29 51 | 30 25 | 30 59 | 31 32 | 32 6 | 32 39 | 33 13 |
| 40 | 28 45 | 29 19 | 29 52 | 30 26 | 31 0 | 31 33 | 32 7 | 32 41 | 33 15 |
| 50 | 28 46 | 29 20 | 29 54 | 30 27 | 31 1 | 31 35 | 32 8 | 32 42 | 33 16 |
| 78 0 | 28 47 | 29 21 | 29 55 | 30 28 | 31 2 | 31 36 | 32 10 | 32 43 | 33 17 |
| 10 | 28 48 | 29 22 | 29 56 | 30 30 | 31 3 | 31 37 | 32 11 | 32 45 | 33 18 |
| 20 | 28 49 | 29 23 | 29 57 | 30 31 | 31 4 | 31 38 | 32 12 | 32 46 | 33 19 |
| 30 | 28 50 | 29 24 | 29 58 | 30 32 | 31 5 | 31 39 | 32 13 | 32 47 | 33 21 |
| 40 | 28 51 | 29 25 | 29 59 | 30 33 | 31 7 | 31 40 | 32 14 | 32 48 | 33 22 |
| 50 | 28 52 | 29 26 | 30 0 | 30 34 | 31 8 | 31 41 | 32 15 | 32 49 | 33 23 |
| 79 0 | 28 53 | 29 27 | 30 1 | 30 35 | 31 9 | 31 43 | 32 16 | 32 50 | 33 24 |
| 10 | 28 54 | 29 28 | 30 2 | 30 36 | 31 10 | 31 44 | 32 18 | 32 51 | 33 25 |
| 20 | 28 55 | 29 29 | 30 3 | 30 37 | 31 11 | 31 45 | 32 19 | 32 53 | 33 26 |
| 30 | 28 56 | 29 30 | 30 4 | 30 38 | 31 12 | 31 46 | 32 20 | 32 54 | 33 27 |
| 40 | 28 57 | 29 31 | 30 5 | 30 39 | 31 13 | 31 47 | 32 21 | 32 55 | 33 29 |
| 50 | 28 58 | 29 32 | 30 6 | 30 40 | 31 14 | 31 48 | 32 22 | 32 56 | 33 30 |

Add for Sec. of Par.

| | 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|---|
| | ″ | ″ | ″ | ″ | ″ |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 5 | 6 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 15 |
| 30 | 16 | 17 | 18 | 19 | 21 |
| 40 | 22 | 23 | 24 | 25 | 26 |
| 50 | 27 | 28 | 29 | 30 | 31 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 5 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 15 |
| 30 | 16 | 17 | 19 | 20 | 21 |
| 40 | 22 | 23 | 24 | 25 | 26 |
| 50 | 27 | 28 | 29 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 15 |
| 30 | 16 | 18 | 19 | 20 | 21 |
| 40 | 22 | 23 | 24 | 25 | 26 |
| 50 | 27 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 15 |
| 30 | 16 | 18 | 19 | 20 | 21 |
| 40 | 22 | 23 | 24 | 25 | 26 |
| 50 | 27 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 16 |
| 30 | 17 | 18 | 19 | 20 | 21 |
| 40 | 22 | 23 | 24 | 25 | 27 |
| 50 | 28 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 14 | 16 |
| 30 | 17 | 18 | 19 | 20 | 21 |
| 40 | 22 | 23 | 24 | 26 | 27 |
| 50 | 28 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 15 | 16 |
| 30 | 17 | 18 | 19 | 20 | 21 |
| 40 | 22 | 23 | 25 | 26 | 27 |
| 50 | 28 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 15 | 16 |
| 30 | 17 | 18 | 19 | 20 | 21 |
| 40 | 23 | 24 | 25 | 26 | 27 |
| 50 | 28 | 29 | 30 | 32 | 33 |
| 0 | 0 | 1 | 2 | 3 | 4 |
| 10 | 6 | 7 | 8 | 9 | 10 |
| 20 | 11 | 12 | 13 | 15 | 16 |
| 30 | 17 | 18 | 19 | 20 | 21 |
| 40 | 23 | 24 | 25 | 26 | 27 |
| 50 | 28 | 29 | 30 | 32 | 33 |

Add for Minutes of Moon's Alt. { 1′ 0″ | 2′ 0″ | 3′ 0″ | 4′ 1″ | 5′ 1″ | 6′ 1″ | 7′ 1″ | 8′ 1″ | 9′ 1″

Add for Alt. of Sun.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 80 | 5 |
| 90 | 5 |

Add for Alt. of Star.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 1 |
| 10 | 1 |
| 20 | 0 |
| 30 | 0 |
| 40 | 0 |
| 50 | 0 |
| 60 | 0 |
| 70 | 0 |
| 80 | 0 |
| 90 | 0 |

# TABLE XXX.

## CORRECTION OF THE MOON'S APPARENT ALTITUDE.

| ☽App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Add for Sec. of Par. 0″ | 2″ | 4″ | 6″ | 8″ | Add for Minutes of Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ″ | ″ | ″ | ″ | ′ ″ |
| 80 0 | 8 52 | 9 3 | 9 13 | 9 23 | 9 34 | 9 44 | 9 55 | 10 5 | 10 15 | 0 | 0 | 1 | 1 | 1 | |
| 10 | 8 43 | 8 53 | 9 4 | 9 14 | 9 24 | 9 34 | 9 45 | 9 55 | 10 5 | 10 | 2 | 2 | 3 | 3 | 0 10 |
| 20 | 8 34 | 8 44 | 8 54 | 9 5 | 9 15 | 9 25 | 9 35 | 9 45 | 9 55 | 20 | 3 | 4 | 4 | 5 | 1 9 |
| 30 | 8 25 | 8 35 | 8 45 | 8 55 | 9 5 | 9 15 | 9 25 | 9 35 | 9 45 | 30 | 5 | 5 | 6 | 6 | 2 8 |
| 40 | 8 16 | 8 26 | 8 36 | 8 46 | 8 55 | 9 5 | 9 15 | 9 24 | 9 34 | 40 | 7 | 7 | 7 | 8 | 3 7 |
| 50 | 8 7 | 8 17 | 8 27 | 8 36 | 8 46 | 8 55 | 9 5 | 9 14 | 9 24 | 50 | 8 | 9 | 9 | 9 | 10 4 6 |
| 81 0 | 7 58 | 8 8 | 8 17 | 8 27 | 8 36 | 8 45 | 8 55 | 9 4 | 9 14 | 0 | 0 | 0 | 1 | 1 | 1 5 5 |
| 10 | 7 49 | 7 59 | 8 8 | 8 17 | 8 26 | 8 36 | 8 45 | 8 54 | 9 3 | 10 | 1 | 2 | 2 | 2 | 3 6 4 |
| 20 | 7 40 | 7 50 | 7 59 | 8 8 | 8 17 | 8 26 | 8 35 | 8 44 | 8 53 | 20 | 3 | 3 | 4 | 4 | 4 7 3 |
| 30 | 7 31 | 7 40 | 7 49 | 7 58 | 8 7 | 8 16 | 8 25 | 8 34 | 8 42 | 30 | 4 | 5 | 5 | 5 | 6 8 2 |
| 40 | 7 22 | 7 31 | 7 40 | 7 49 | 7 57 | 8 6 | 8 15 | 8 23 | 8 32 | 40 | 6 | 6 | 7 | 7 | 7 9 1 |
| 50 | 7 13 | 7 22 | 7 31 | 7 39 | 7 48 | 7 56 | 8 5 | 8 13 | 8 22 | 50 | 7 | 8 | 8 | 8 | 9 |
| 82 0 | 7 4 | 7 13 | 7 21 | 7 30 | 7 38 | 7 46 | 7 55 | 8 3 | 8 11 | 0 | 0 | 0 | 1 | 1 | 1 |
| 10 | 6 55 | 7 4 | 7 12 | 7 20 | 7 28 | 7 36 | 7 45 | 7 53 | 8 1 | 10 | 1 | 2 | 2 | 2 | 2 ′ ″ |
| 20 | 6 46 | 6 55 | 7 3 | 7 11 | 7 19 | 7 27 | 7 35 | 7 43 | 7 51 | 20 | 3 | 3 | 3 | 3 | 4 0 10 |
| 30 | 6 37 | 6 45 | 6 53 | 7 1 | 7 9 | 7 17 | 7 25 | 7 32 | 7 40 | 30 | 4 | 4 | 4 | 5 | 5 1 9 |
| 40 | 6 28 | 6 36 | 6 44 | 6 52 | 6 59 | 7 7 | 7 15 | 7 22 | 7 30 | 40 | 5 | 5 | 6 | 6 | 6 2 8 |
| 50 | 6 19 | 6 27 | 6 35 | 6 42 | 6 50 | 6 57 | 7 4 | 7 12 | 7 19 | 50 | 7 | 7 | 7 | 8 | 3 7 |
| 83 0 | 6 10 | 6 18 | 6 25 | 6 32 | 6 40 | 6 47 | 6 54 | 7 2 | 7 9 | 0 | 0 | 0 | 0 | 1 | 1 4 6 |
| 10 | 6 1 | 6 9 | 6 16 | 6 23 | 6 30 | 6 37 | 6 44 | 6 52 | 6 59 | 10 | 1 | 1 | 2 | 2 | 2 5 5 |
| 20 | 5 52 | 5 59 | 6 6 | 6 13 | 6 20 | 6 27 | 6 34 | 6 41 | 6 48 | 20 | 2 | 2 | 3 | 3 | 3 6 4 |
| 30 | 5 43 | 5 50 | 5 57 | 6 4 | 6 11 | 6 17 | 6 24 | 6 31 | 6 38 | 30 | 3 | 4 | 4 | 4 | 4 7 3 |
| 40 | 5 34 | 5 41 | 5 48 | 5 54 | 6 1 | 6 8 | 6 14 | 6 21 | 6 27 | 40 | 5 | 5 | 5 | 5 | 5 8 2 |
| 50 | 5 25 | 5 32 | 5 38 | 5 45 | 5 51 | 5 58 | 6 4 | 6 11 | 6 17 | 50 | 6 | 6 | 6 | 6 | 7 9 1 |
| 84 0 | 5 16 | 5 23 | 5 29 | 5 35 | 5 42 | 5 48 | 5 54 | 6 0 | 6 7 | 0 | 0 | 0 | 0 | 1 | 1 |
| 10 | 5 7 | 5 13 | 5 20 | 5 26 | 5 32 | 5 38 | 5 44 | 5 50 | 5 56 | 10 | 1 | 1 | 1 | 2 | 2 ′ ″ |
| 20 | 4 58 | 5 4 | 5 10 | 5 16 | 5 22 | 5 28 | 5 34 | 5 40 | 5 46 | 20 | 2 | 2 | 2 | 2 | 3 0 10 |
| 30 | 4 49 | 4 55 | 5 1 | 5 7 | 5 12 | 5 18 | 5 24 | 5 30 | 5 35 | 30 | 3 | 3 | 3 | 3 | 4 1 9 |
| 40 | 4 40 | 4 45 | 4 51 | 4 57 | 5 3 | 5 8 | 5 14 | 5 19 | 5 25 | 40 | 4 | 4 | 4 | 4 | 5 2 8 |
| 50 | 4 31 | 4 36 | 4 42 | 4 47 | 4 53 | 4 58 | 5 4 | 5 9 | 5 14 | 50 | 5 | 5 | 5 | 5 | 6 3 7 |
| 85 0 | 4 22 | 4 27 | 4 33 | 4 38 | 4 43 | 4 48 | 4 54 | 4 59 | 5 4 | 0 | 0 | 0 | 0 | 0 | 1 4 6 |
| 10 | 4 13 | 4 18 | 4 23 | 4 28 | 4 33 | 4 38 | 4 43 | 4 49 | 4 54 | 10 | 1 | 1 | 1 | 1 | 1 5 5 |
| 20 | 4 4 | 4 9 | 4 14 | 4 19 | 4 24 | 4 28 | 4 33 | 4 38 | 4 43 | 20 | 2 | 2 | 2 | 2 | 2 6 4 |
| 30 | 3 55 | 4 0 | 4 4 | 4 9 | 4 14 | 4 19 | 4 23 | 4 28 | 4 33 | 30 | 2 | 2 | 3 | 3 | 3 7 3 |
| 40 | 3 46 | 3 50 | 3 55 | 4 0 | 4 4 | 4 9 | 4 13 | 4 18 | 4 22 | 40 | 3 | 3 | 3 | 4 | 4 8 2 |
| 50 | 3 37 | 3 41 | 3 46 | 3 50 | 3 54 | 3 59 | 4 3 | 4 7 | 4 12 | 50 | 4 | 4 | 4 | 4 | 5 9 1 |
| 86 0 | 3 28 | 3 32 | 3 36 | 3 40 | 3 45 | 3 49 | 3 53 | 3 57 | 4 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 3 19 | 3 23 | 3 27 | 3 31 | 3 35 | 3 39 | 3 43 | 3 47 | 3 51 | 10 | 1 | 1 | 1 | 1 | 1 ′ ″ |
| 20 | 3 10 | 3 14 | 3 17 | 3 21 | 3 25 | 3 29 | 3 33 | 3 37 | 3 40 | 20 | 1 | 1 | 1 | 2 | 2 0 10 |
| 30 | 3 1 | 3 4 | 3 8 | 3 12 | 3 15 | 3 19 | 3 23 | 3 26 | 3 30 | 30 | 2 | 2 | 2 | 2 | 2 1 9 |
| 40 | 2 52 | 2 55 | 2 59 | 3 2 | 3 6 | 3 9 | 3 13 | 3 16 | 3 20 | 40 | 2 | 3 | 3 | 3 | 3 2 8 |
| 50 | 2 43 | 2 46 | 2 49 | 2 52 | 2 56 | 2 59 | 3 2 | 3 6 | 3 9 | 50 | 3 | 3 | 3 | 3 | 4 3 7 |
| 87 0 | 2 33 | 2 37 | 2 40 | 2 43 | 2 46 | 2 49 | 2 52 | 2 55 | 2 59 | 0 | 0 | 0 | 0 | 0 | 0 4 6 |
| 10 | 2 24 | 2 27 | 2 30 | 2 33 | 2 36 | 2 39 | 2 42 | 2 45 | 2 48 | 10 | 0 | 1 | 1 | 1 | 1 5 5 |
| 20 | 2 15 | 2 18 | 2 21 | 2 24 | 2 26 | 2 29 | 2 32 | 2 35 | 2 38 | 20 | 1 | 1 | 1 | 1 | 1 6 4 |
| 30 | 2 6 | 2 9 | 2 11 | 2 14 | 2 17 | 2 19 | 2 22 | 2 25 | 2 27 | 30 | 1 | 1 | 1 | 2 | 2 7 3 |
| 40 | 1 57 | 2 0 | 2 2 | 2 4 | 2 7 | 2 9 | 2 12 | 2 14 | 2 17 | 40 | 2 | 2 | 2 | 2 | 2 8 2 |
| 50 | 1 48 | 1 50 | 1 53 | 1 55 | 1 57 | 1 59 | 2 2 | 2 4 | 2 6 | 50 | 2 | 2 | 2 | 2 | 3 9 1 |
| 88 0 | 1 39 | 1 41 | 1 43 | 1 45 | 1 47 | 1 49 | 1 52 | 1 54 | 1 56 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 1 30 | 1 32 | 1 34 | 1 36 | 1 38 | 1 40 | 1 41 | 1 43 | 1 45 | 10 | 0 | 0 | 0 | 0 | 0 ′ ″ |
| 20 | 1 21 | 1 23 | 1 24 | 1 26 | 1 28 | 1 30 | 1 31 | 1 33 | 1 35 | 20 | 1 | 1 | 1 | 1 | 1 0 10 |
| 30 | 1 12 | 1 13 | 1 15 | 1 16 | 1 18 | 1 20 | 1 21 | 1 23 | 1 24 | 30 | 1 | 1 | 1 | 1 | 1 1 9 |
| 40 | 1 3 | 1 4 | 1 5 | 1 7 | 1 8 | 1 10 | 1 11 | 1 12 | 1 14 | 40 | 1 | 1 | 1 | 1 | 1 2 8 |
| 50 | 0 54 | 0 55 | 0 56 | 0 57 | 0 58 | 1 0 | 1 1 | 1 2 | 1 3 | 50 | 1 | 1 | 1 | 1 | 2 3 7 |
| 89 0 | 0 45 | 0 46 | 0 47 | 0 48 | 0 49 | 0 50 | 0 51 | 0 52 | 0 53 | 0 | 0 | 0 | 0 | 0 | 0 4 6 |
| 10 | 0 35 | 0 36 | 0 37 | 0 38 | 0 39 | 0 40 | 0 41 | 0 42 | 0 42 | 10 | 0 | 0 | 0 | 0 | 0 5 5 |
| 20 | 0 26 | 0 27 | 0 28 | 0 28 | 0 29 | 0 30 | 0 31 | 0 31 | 0 32 | 20 | 0 | 0 | 0 | 0 | 0 6 4 |
| 30 | 0 17 | 0 18 | 0 18 | 0 19 | 0 19 | 0 20 | 0 20 | 0 21 | 0 21 | 30 | 0 | 0 | 0 | 0 | 0 7 3 |
| 40 | 0 8 | 0 9 | 0 9 | 0 9 | 0 10 | 0 10 | 0 10 | 0 11 | 0 11 | 40 | 0 | 0 | 0 | 0 | 0 8 2 |
| 50 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 50 | 1 | 1 | 1 | 1 | 1 9 1 |

# TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

| ☽ App. Alt. | Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ |
|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 80 0 | 28 59 | 29 33 | 30 7 | 30 41 | 31 15 | 31 49 | 32 23 | 32 57 | 33 31 |
| 10 | 29 0 | 29 34 | 30 8 | 30 42 | 31 16 | 31 50 | 32 24 | 32 58 | 33 32 |
| 20 | 29 1 | 29 35 | 30 9 | 30 43 | 31 17 | 31 51 | 32 25 | 32 59 | 33 33 |
| 30 | 29 2 | 29 36 | 30 10 | 30 44 | 31 18 | 31 52 | 32 26 | 33 0 | 33 34 |
| 40 | 29 2 | 29 37 | 30 11 | 30 45 | 31 19 | 31 53 | 32 27 | 33 1 | 33 35 |
| 50 | 29 3 | 29 37 | 30 12 | 30 46 | 31 20 | 31 54 | 32 28 | 33 2 | 33 36 |
| 81 0 | 29 4 | 29 38 | 30 12 | 30 46 | 31 21 | 31 55 | 32 29 | 33 3 | 33 37 |
| 10 | 29 5 | 29 39 | 30 13 | 30 47 | 31 21 | 31 55 | 32 30 | 33 4 | 33 38 |
| 20 | 29 6 | 29 40 | 30 14 | 30 48 | 31 22 | 31 56 | 32 31 | 33 5 | 33 39 |
| 30 | 29 6 | 29 41 | 30 15 | 30 49 | 31 23 | 31 57 | 32 31 | 33 5 | 33 39 |
| 40 | 29 7 | 29 41 | 30 16 | 30 50 | 31 24 | 31 58 | 32 32 | 33 6 | 33 40 |
| 50 | 29 8 | 29 42 | 30 16 | 30 51 | 31 25 | 31 59 | 32 33 | 33 7 | 33 41 |
| 82 0 | 29 9 | 29 43 | 30 17 | 30 51 | 31 26 | 32 0 | 32 34 | 33 8 | 33 42 |
| 10 | 29 10 | 29 44 | 30 18 | 30 52 | 31 26 | 32 0 | 32 35 | 33 9 | 33 43 |
| 20 | 29 10 | 29 44 | 30 19 | 30 53 | 31 27 | 32 1 | 32 35 | 33 9 | 33 44 |
| 30 | 29 11 | 29 45 | 30 19 | 30 54 | 31 28 | 32 2 | 32 36 | 33 10 | 33 45 |
| 40 | 29 12 | 29 46 | 30 20 | 30 54 | 31 29 | 32 3 | 32 37 | 33 11 | 33 45 |
| 50 | 29 12 | 29 47 | 30 21 | 30 55 | 31 29 | 32 3 | 32 38 | 33 12 | 33 46 |
| 83 0 | 29 13 | 29 47 | 30 21 | 30 56 | 31 30 | 32 4 | 32 38 | 33 12 | 33 47 |
| 10 | 29 13 | 29 48 | 30 22 | 30 56 | 31 30 | 32 5 | 32 39 | 33 13 | 33 48 |
| 20 | 29 14 | 29 48 | 30 23 | 30 57 | 31 31 | 32 6 | 32 40 | 33 14 | 33 48 |
| 30 | 29 15 | 29 49 | 30 23 | 30 58 | 31 32 | 32 6 | 32 40 | 33 15 | 33 49 |
| 40 | 29 15 | 29 50 | 30 24 | 30 58 | 31 33 | 32 7 | 32 41 | 33 15 | 33 49 |
| 50 | 29 16 | 29 50 | 30 24 | 30 59 | 31 33 | 32 7 | 32 42 | 33 16 | 33 50 |
| 84 0 | 29 16 | 29 51 | 30 25 | 30 59 | 31 34 | 32 8 | 32 42 | 33 16 | 33 51 |
| 10 | 29 17 | 29 51 | 30 26 | 31 0 | 31 34 | 32 9 | 32 43 | 33 17 | 33 51 |
| 20 | 29 17 | 29 52 | 30 26 | 31 1 | 31 35 | 32 9 | 32 43 | 33 18 | 33 52 |
| 30 | 29 18 | 29 52 | 30 27 | 31 1 | 31 35 | 32 10 | 32 44 | 33 18 | 33 53 |
| 40 | 29 19 | 29 53 | 30 27 | 31 2 | 31 36 | 32 10 | 32 45 | 33 19 | 33 53 |
| 50 | 29 19 | 29 54 | 30 28 | 31 2 | 31 36 | 32 11 | 32 45 | 33 19 | 33 54 |
| 85 0 | 29 20 | 29 54 | 30 28 | 31 3 | 31 37 | 32 11 | 32 46 | 33 20 | 33 54 |
| 10 | 29 20 | 29 54 | 30 28 | 31 3 | 31 37 | 32 12 | 32 46 | 33 20 | 33 55 |
| 20 | 29 20 | 29 55 | 30 29 | 31 4 | 31 38 | 32 12 | 32 47 | 33 21 | 33 55 |
| 30 | 29 21 | 29 55 | 30 29 | 31 4 | 31 39 | 32 13 | 32 47 | 33 22 | 33 56 |
| 40 | 29 21 | 29 56 | 30 30 | 31 4 | 31 39 | 32 13 | 32 47 | 33 22 | 33 56 |
| 50 | 29 22 | 29 56 | 30 31 | 31 5 | 31 39 | 32 14 | 32 48 | 33 22 | 33 57 |
| 86 0 | 29 22 | 29 56 | 30 31 | 31 5 | 31 40 | 32 14 | 32 48 | 33 23 | 33 57 |
| 10 | 29 22 | 29 57 | 30 31 | 31 6 | 31 40 | 32 14 | 32 49 | 33 23 | 33 57 |
| 20 | 29 23 | 29 57 | 30 32 | 31 6 | 31 40 | 32 15 | 32 49 | 33 24 | 33 58 |
| 30 | 29 23 | 29 58 | 30 32 | 31 6 | 31 41 | 32 15 | 32 50 | 33 24 | 33 58 |
| 40 | 29 23 | 29 58 | 30 32 | 31 7 | 31 41 | 32 16 | 32 50 | 33 24 | 33 59 |
| 50 | 29 24 | 29 58 | 30 32 | 31 7 | 31 41 | 32 16 | 32 50 | 33 25 | 33 59 |
| 87 0 | 29 24 | 29 58 | 30 33 | 31 7 | 31 42 | 32 16 | 32 50 | 33 25 | 33 59 |
| 10 | 29 24 | 29 59 | 30 33 | 31 8 | 31 42 | 32 16 | 32 51 | 33 25 | 34 0 |
| 20 | 29 24 | 29 59 | 30 33 | 31 8 | 31 42 | 32 17 | 32 51 | 33 26 | 34 0 |
| 30 | 29 25 | 29 59 | 30 34 | 31 8 | 31 43 | 32 17 | 32 51 | 33 26 | 34 0 |
| 40 | 29 25 | 29 59 | 30 34 | 31 8 | 31 43 | 32 17 | 32 51 | 33 26 | 34 0 |
| 50 | 29 25 | 30 0 | 30 34 | 31 8 | 31 43 | 32 17 | 32 52 | 33 26 | 34 1 |
| 88 0 | 29 25 | 30 0 | 30 34 | 31 9 | 31 43 | 32 18 | 32 52 | 33 26 | 34 1 |
| 10 | 29 26 | 30 0 | 30 34 | 31 9 | 31 43 | 32 18 | 32 52 | 33 27 | 34 1 |
| 20 | 29 26 | 30 0 | 30 35 | 31 9 | 31 44 | 32 18 | 32 53 | 33 27 | 34 1 |
| 30 | 29 26 | 30 0 | 30 35 | 31 9 | 31 44 | 32 18 | 32 53 | 33 27 | 34 1 |
| 40 | 29 26 | 30 0 | 30 35 | 31 9 | 31 44 | 32 18 | 32 53 | 33 27 | 34 1 |
| 50 | 29 26 | 30 0 | 30 35 | 31 10 | 31 44 | 32 19 | 32 53 | 33 27 | 34 2 |
| 89 0 | 29 26 | 30 0 | 30 35 | 31 10 | 31 44 | 32 19 | 32 53 | 33 27 | 34 2 |
| 10 | 29 26 | 30 1 | 30 35 | 31 10 | 31 44 | 32 19 | 32 53 | 33 27 | 34 2 |
| 20 | 29 26 | 30 1 | 30 35 | 31 10 | 31 44 | 32 19 | 32 53 | 33 27 | 34 2 |
| 30 | 29 26 | 30 1 | 30 35 | 31 10 | 31 44 | 32 19 | 32 53 | 33 27 | 34 2 |
| 40 | 29 26 | 30 1 | 30 35 | 31 10 | 31 44 | 32 19 | 32 53 | 33 27 | 34 2 |
| 50 | 29 26 | 30 1 | 30 35 | 31 10 | 31 44 | 32 19 | 32 53 | 33 27 | 34 2 |

Add for Minutes of Moon's Alt. { 1′ 0″ | 2′ 0″ | 3′ 0″ | 4′ 0″ | 5′ 0″ | 6′ 0″ | 7′ 0″ | 8′ 0″ | 9′ 1″

| Add for Sec. of Par 0″ | 2″ | 4″ | 6″ | 8″ |
|---|---|---|---|---|
| ″ | ″ | ″ | ″ | ″ |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 12 | 14 | 15 |
| 30 | 17 | 18 | 19 | 20 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 28 | 29 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 12 | 14 | 15 |
| 30 | 17 | 18 | 19 | 20 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 28 | 29 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 13 | 14 | 15 |
| 30 | 17 | 18 | 19 | 21 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 28 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 13 | 14 | 15 |
| 30 | 17 | 18 | 19 | 21 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 28 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 13 | 14 | 15 |
| 30 | 17 | 18 | 19 | 21 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 28 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 13 | 14 | 15 |
| 30 | 17 | 18 | 19 | 21 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 13 | 14 | 15 |
| 30 | 17 | 18 | 19 | 21 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 29 | 30 | 31 | 32 |
| 0 | 0 | 1 | 2 | 3 |
| 10 | 6 | 7 | 8 | 9 |
| 20 | 11 | 13 | 14 | 15 |
| 30 | 17 | 18 | 19 | 21 |
| 40 | 23 | 24 | 25 | 26 |
| 50 | 29 | 30 | 31 | 32 |

Add for Alt. of SUN.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 80 | 5 |
| 90 | 5 |

Add for Alt. of STAR.

| ° | ″ |
|---|---|
| 3 | 8 |
| 4 | 5 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 1 |
| 10 | 1 |
| 20 | 0 |
| 30 | 0 |
| 40 | 0 |
| 50 | 0 |
| 60 | 0 |
| 70 | 0 |
| 80 | 0 |
| 90 | 0 |

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

0 Hour.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | ¼ . | 51921 | 12127 | 17345 | 72333 | 91715 | 07551 | 20941 | 32539 | 42770 | 51921 | 60200 | | |
| 1 | ½ .67757 | 74710 | 81147 | 87139 | 92745 | 98011 | 02976 | 07672 | 12127 | 16365 | 20406 | 24267 | | |
| 2 | ¾ .27963 | 31509 | 34916 | 38194 | 41352 | 44400 | 46345 | 50193 | 52951 | 55623 | 58216 | 60734 | | |
| 3 | 63181 | 65561 | 67877 | 70133 | 72332 | 74477 | 76570 | 78614 | 80611 | 82563 | 84472 | 86340 | | |
| 4 | 1 .88168 | 89959 | 91714 | 93434 | 95121 | 96775 | 98399 | 99992 | 01557 | 03095 | 04605 | 06090 | | |
| 5 | 6.07550 | 08985 | 10398 | 11787 | 13155 | 14502 | 15828 | 17134 | 18421 | 19689 | 20938 | 22170 | | |
| 6 | 23385 | 24583 | 25765 | 26931 | 28081 | 29217 | 30337 | 31444 | 32536 | 33615 | 34681 | 35734 | | |
| 7 | 36774 | 37802 | 38817 | 39821 | 40814 | 41795 | 42766 | 43726 | 44675 | 45614 | 46543 | 47462 | | |
| 8 | 48372 | 49271 | 50162 | 51044 | 51916 | 52780 | 53636 | 54484 | 55323 | 56154 | 56977 | 57792 | | |
| 9 | 58600 | 59401 | 60194 | 60980 | 61759 | 62531 | 63296 | 64054 | 64806 | 65552 | 66291 | 67024 | | |
| 10 | 6.67751 | 68471 | 69186 | 69895 | 70598 | 71296 | 71988 | 72674 | 73355 | 74031 | 74702 | 75367 | s | |
| 11 | 76028 | 76683 | 77334 | 77979 | 78620 | 79256 | 79888 | 80515 | 81137 | 81756 | 82369 | 82979 | 1 | 119 |
| 12 | 83584 | 84185 | 84782 | 85374 | 85963 | 86548 | 87129 | 87706 | 88279 | 88848 | 89414 | 89976 | 2 | 238 |
| 13 | 90535 | 91089 | 91641 | 92189 | 92733 | 93274 | 93812 | 94346 | 94877 | 95405 | 95930 | 96451 | 3 | 358 |
| 14 | ¾ .96970 | 97485 | 97997 | 98506 | 99013 | 99516 | 00017 | 00514 | 01009 | 01501 | 01990 | 02476 | 4 | 476 |
| 15 | 7.02960 | 03441 | 03920 | 04395 | 04869 | 05339 | 05807 | 06273 | 06736 | 07196 | 07655 | 08110 | s | |
| 16 | 08564 | 09015 | 09464 | 09910 | 10354 | 10796 | 11236 | 11673 | 12108 | 12541 | 12972 | 13401 | 1 | 84 |
| 17 | 13827 | 14252 | 14674 | 15095 | 15513 | 15930 | 16344 | 16756 | 17167 | 17575 | 17982 | 18387 | 2 | 168 |
| 18 | 18790 | 19191 | 19590 | 19987 | 20383 | 20776 | 21168 | 21558 | 21947 | 22333 | 22719 | 23102 | 3 | 252 |
| 19 | 23483 | 23863 | 24241 | 24618 | 24993 | 25366 | 25738 | 26108 | 26477 | 26844 | 27210 | 27573 | 4 | 336 |
| 20 | 7.27936 | 28297 | 28656 | 29014 | 29371 | 29726 | 30079 | 30431 | 30782 | 31131 | 31479 | 31826 | s | |
| 21 | 32171 | 32515 | 32857 | 33198 | 33538 | 33876 | 34213 | 34549 | 34884 | 35217 | 35549 | 35879 | 1 | 65 |
| 22 | 36209 | 36537 | 36864 | 37189 | 37514 | 37837 | 38159 | 38480 | 38800 | 39118 | 39435 | 39752 | 2 | 130 |
| 23 | 40067 | 40380 | 40693 | 41005 | 41315 | 41625 | 41933 | 42240 | 42546 | 42851 | 43155 | 43458 | 3 | 195 |
| 24 | 43760 | 44061 | 44361 | 44659 | 44957 | 45254 | 45549 | 45844 | 46138 | 46430 | 46722 | 47013 | 4 | 260 |
| 25 | 7.47302 | 47591 | 47879 | 48166 | 48452 | 48737 | 49021 | 49304 | 49586 | 49867 | 50148 | 50427 | s | |
| 26 | 50706 | 50983 | 51260 | 51536 | 51811 | 52085 | 52358 | 52631 | 52902 | 53173 | 53443 | 53712 | 1 | 53 |
| 27 | 53980 | 54247 | 54514 | 54780 | 55045 | 55308 | 55572 | 55834 | 56096 | 56357 | 56617 | 56876 | 2 | 106 |
| 28 | 57135 | 57393 | 57650 | 57906 | 58162 | 58416 | 58670 | 58924 | 59176 | 59428 | 59679 | 59929 | 3 | 159 |
| 29 | 60179 | 60428 | 60676 | 60924 | 61170 | 61417 | 61662 | 61907 | 62151 | 62394 | 62636 | 62878 | 4 | 212 |
| 30 | 7.63120 | 63360 | 63600 | 63839 | 64078 | 64316 | 64553 | 64790 | 65026 | 65261 | 65496 | 65730 | s | |
| 31 | 65964 | 66196 | 66429 | 66660 | 66891 | 67121 | 67351 | 67580 | 67809 | 68037 | 68264 | 68491 | 1 | 45 |
| 32 | 68717 | 68942 | 69167 | 69392 | 69616 | 69839 | 70061 | 70283 | 70505 | 70726 | 70946 | 71166 | 2 | 90 |
| 33 | 71385 | 71604 | 71822 | 72040 | 72257 | 72473 | 72689 | 72904 | 73119 | 73334 | 73548 | 73760 | 3 | 134 |
| 34 | 73974 | 74186 | 74398 | 74609 | 74819 | 75030 | 75239 | 75448 | 75657 | 75865 | 76073 | 76280 | 4 | 178 |
| 35 | 7.76487 | 76693 | 76898 | 77104 | 77308 | 77513 | 77716 | 77920 | 78122 | 78325 | 78526 | 78728 | s | |
| 36 | 78929 | 79129 | 79329 | 79529 | 79728 | 79926 | 80124 | 80322 | 80519 | 80716 | 80912 | 81108 | 1 | 39 |
| 37 | 81303 | 81498 | 81693 | 81887 | 82081 | 82274 | 82467 | 82659 | 82851 | 83043 | 83234 | 83424 | 2 | 77 |
| 38 | 83615 | 83804 | 83994 | 84183 | 84372 | 84560 | 84747 | 84935 | 85122 | 85308 | 85494 | 85680 | 3 | 116 |
| 39 | 85866 | 86050 | 86235 | 86419 | 86603 | 86786 | 86969 | 87152 | 87334 | 87516 | 87697 | 87878 | 4 | 154 |
| 40 | 7.88059 | 88240 | 88419 | 88599 | 88778 | 88957 | 89135 | 89314 | 89491 | 89668 | 89846 | 90022 | s | |
| 41 | 90198 | 90374 | 90550 | 90725 | 90900 | 91074 | 91248 | 91422 | 91596 | 91769 | 91941 | 92114 | 1 | 34 |
| 42 | 92286 | 92457 | 92629 | 92800 | 92970 | 93141 | 93311 | 93480 | 93650 | 93819 | 93987 | 94156 | 2 | 68 |
| 43 | 94324 | 94491 | 94659 | 94826 | 94992 | 95159 | 95325 | 95491 | 95656 | 95821 | 95986 | 96150 | 3 | 102 |
| 44 | 96315 | 96478 | 96642 | 96805 | 96968 | 97131 | 97293 | 97455 | 97617 | 97778 | 97939 | 98100 | 4 | 137 |
| 45 | ¾ .98260 | 98421 | 98580 | 98740 | 98899 | 99058 | 99217 | 99375 | 99534 | 99691 | 99849 | 00006 | s | |
| 46 | 8.00163 | 00320 | 00476 | 00632 | 00788 | 00944 | 01099 | 01254 | 01409 | 01563 | 01717 | 01871 | 1 | 31 |
| 47 | 02025 | 02178 | 02331 | 02484 | 02636 | 02789 | 02941 | 03092 | 03244 | 03395 | 03546 | 03697 | 2 | 62 |
| 48 | 03847 | 03997 | 04147 | 04297 | 04446 | 04595 | 04744 | 04892 | 05041 | 05189 | 05336 | 05484 | 3 | 92 |
| 49 | 05631 | 05778 | 05925 | 06072 | 06218 | 06364 | 06510 | 06655 | 06800 | 06945 | 07090 | 07235 | 4 | 122 |
| 50 | 8.07379 | 07523 | 07667 | 07811 | 07954 | 08097 | 08240 | 08383 | 08525 | 08667 | 08809 | 08951 | s | |
| 51 | 09092 | 09233 | 09374 | 09515 | 09656 | 09796 | 09936 | 10076 | 10216 | 10355 | 10494 | 10633 | 1 | 27 |
| 52 | 10772 | 10910 | 11048 | 11187 | 11324 | 11462 | 11599 | 11736 | 11873 | 12010 | 12147 | 12283 | 2 | 55 |
| 53 | 12419 | 12555 | 12691 | 12826 | 12961 | 13096 | 13231 | 13366 | 13500 | 13634 | 13768 | 13902 | 3 | 82 |
| 54 | 14035 | 14169 | 14302 | 14434 | 14567 | 14700 | 14832 | 14964 | 15096 | 15228 | 15359 | 15490 | 4 | 110 |
| 55 | 8.15621 | 15752 | 15883 | 16013 | 16144 | 16274 | 16404 | 16533 | 16663 | 16792 | 16921 | 17050 | s | |
| 56 | 17179 | 17307 | 17436 | 17564 | 17692 | 17820 | 17947 | 18074 | 18202 | 18329 | 18456 | 18582 | 1 | 25 |
| 57 | 18708 | 18835 | 18961 | 19087 | 19212 | 19338 | 19463 | 19588 | 19713 | 19838 | 19963 | 20087 | 2 | 50 |
| 58 | 20211 | 20335 | 20459 | 20583 | 20706 | 20830 | 20953 | 21076 | 21198 | 21321 | 21444 | 21566 | 3 | 75 |
| 59 | 21688 | 21810 | 21932 | 22053 | 22175 | 22296 | 22417 | 22538 | 22658 | 22779 | 22899 | 23019 | 4 | 100 |

# TABLE XXXI.

## Logarithms for finding the Apparent Time or Horary Angle.

### 1 Hour.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.23140 | 23259 | 23379 | 23499 | 23618 | 23737 | 23856 | 23975 | 24094 | 24212 | 24331 | 24449 | s |
| 1 | 24567 | 24685 | 24802 | 24920 | 25037 | 25155 | 25272 | 25389 | 25505 | 25622 | 25738 | 25855 | 1 \| 23 |
| 2 | 25971 | 26087 | 26203 | 26318 | 26434 | 26549 | 26664 | 26779 | 26894 | 27009 | 27123 | 27238 | 2 \| 46 |
| 3 | 27352 | 27466 | 27580 | 27694 | 27807 | 27921 | 28034 | 28147 | 28260 | 28373 | 28486 | 28599 | 3 \| 70 |
| 4 | 28711 | 28823 | 28935 | 29047 | 29159 | 29271 | 29383 | 29494 | 29605 | 29716 | 29827 | 29938 | 4 \| 93 |
| 5 | 8.30049 | 30159 | 30270 | 30380 | 30490 | 30600 | 30710 | 30820 | 30929 | 31039 | 31148 | 31257 | s |
| 6 | 31366 | 31475 | 31583 | 31692 | 31800 | 31909 | 32016 | 32125 | 32233 | 32340 | 32448 | 32556 | 1 \| 21 |
| 7 | 32663 | 32770 | 32877 | 32984 | 33091 | 33198 | 33304 | 33410 | 33517 | 33623 | 33729 | 33835 | 2 \| 42 |
| 8 | 33940 | 34046 | 34151 | 34257 | 34362 | 34467 | 34572 | 34677 | 34782 | 34886 | 34991 | 35095 | 3 \| 63 |
| 9 | 35199 | 35303 | 35407 | 35511 | 35614 | 35718 | 35821 | 35925 | 36028 | 36131 | 36234 | 36337 | 4 \| 85 |
| 10 | 8.36439 | 36542 | 36644 | 36746 | 36849 | 36951 | 37053 | 37154 | 37256 | 37358 | 37459 | 37560 | s |
| 11 | 37662 | 37763 | 37864 | 37964 | 38065 | 38166 | 38266 | 38366 | 38467 | 38567 | 38667 | 38767 | 1 \| 20 |
| 12 | 38866 | 38966 | 39066 | 39165 | 39264 | 39364 | 39463 | 39562 | 39660 | 39759 | 39858 | 39956 | 2 \| 40 |
| 13 | 40055 | 40153 | 40251 | 40349 | 40447 | 40545 | 40642 | 40740 | 40837 | 40935 | 41032 | 41129 | 3 \| 60 |
| 14 | 41226 | 41323 | 41420 | 41517 | 41613 | 41710 | 41806 | 41902 | 41998 | 42094 | 42191 | 42286 | 4 \| 80 |
| 15 | 8.42382 | 42477 | 42573 | 42668 | 42764 | 42859 | 42954 | 43049 | 43144 | 43238 | 43333 | 43427 | s |
| 16 | 43522 | 43616 | 43710 | 43804 | 43898 | 43992 | 44086 | 44180 | 44273 | 44367 | 44460 | 44554 | 1 \| 18 |
| 17 | 44647 | 44740 | 44833 | 44926 | 45018 | 45111 | 45204 | 45296 | 45388 | 45481 | 45573 | 45665 | 2 \| 37 |
| 18 | 45757 | 45849 | 45940 | 46032 | 46124 | 46215 | 46306 | 46398 | 46489 | 46580 | 46671 | 46762 | 3 \| 55 |
| 19 | 46852 | 46943 | 47034 | 47124 | 47215 | 47305 | 47395 | 47485 | 47575 | 47665 | 47755 | 47844 | 4 \| 74 |
| 20 | 8.47934 | 48024 | 48113 | 48202 | 48292 | 48381 | 48470 | 48559 | 48647 | 48736 | 48825 | 48913 | s |
| 21 | 49002 | 49090 | 49179 | 49267 | 49355 | 49443 | 49531 | 49619 | 49706 | 49794 | 49882 | 49969 | 1 \| 17 |
| 22 | 50056 | 50144 | 50231 | 50318 | 50405 | 50492 | 50579 | 50665 | 50752 | 50839 | 50925 | 51012 | 2 \| 35 |
| 23 | 51098 | 51184 | 51270 | 51356 | 51442 | 51528 | 51614 | 51699 | 51785 | 51871 | 51956 | 52041 | 3 \| 52 |
| 24 | 52127 | 52212 | 52297 | 52382 | 52467 | 52552 | 52636 | 52721 | 52805 | 52890 | 52974 | 53059 | 4 \| 70 |
| 25 | 8.53143 | 53227 | 53311 | 53395 | 53479 | 53563 | 53646 | 53730 | 53814 | 53897 | 53980 | 54064 | s |
| 26 | 54147 | 54230 | 54313 | 54396 | 54479 | 54562 | 54645 | 54727 | 54810 | 54892 | 54975 | 55057 | 1 \| 16 |
| 27 | 55139 | 55221 | 55303 | 55385 | 55467 | 55549 | 55631 | 55713 | 55794 | 55876 | 55957 | 56038 | 2 \| 33 |
| 28 | 56120 | 56201 | 56282 | 56363 | 56444 | 56525 | 56606 | 56687 | 56767 | 56848 | 56928 | 57009 | 3 \| 49 |
| 29 | 57089 | 57169 | 57249 | 57330 | 57410 | 57490 | 57569 | 57649 | 57729 | 57809 | 57888 | 57968 | 4 \| 65 |
| 30 | 8.58047 | 58126 | 58206 | 58285 | 58364 | 58443 | 58522 | 58601 | 58680 | 58759 | 58837 | 58916 | s |
| 31 | 58994 | 59073 | 59151 | 59230 | 59308 | 59386 | 59464 | 59542 | 59620 | 59698 | 59776 | 59853 | 1 \| 15 |
| 32 | 59931 | 60009 | 60086 | 60164 | 60241 | 60318 | 60395 | 60473 | 60550 | 60627 | 60704 | 60781 | 2 \| 31 |
| 33 | 60857 | 60934 | 61011 | 61087 | 61164 | 61240 | 61317 | 61393 | 61469 | 61545 | 61621 | 61697 | 3 \| 46 |
| 34 | 61773 | 61849 | 61925 | 62001 | 62076 | 62152 | 62228 | 62303 | 62379 | 62454 | 62529 | 62604 | 4 \| 62 |
| 35 | 8.62679 | 62755 | 62830 | 62904 | 62979 | 63054 | 63129 | 63203 | 63278 | 63353 | 63427 | 63502 | s |
| 36 | 63576 | 63650 | 63724 | 63798 | 63872 | 63946 | 64020 | 64094 | 64168 | 64242 | 64315 | 64389 | 1 \| 15 |
| 37 | 64463 | 64536 | 64609 | 64683 | 64756 | 64829 | 64902 | 64975 | 65048 | 65121 | 65194 | 65267 | 2 \| 29 |
| 38 | 65340 | 65412 | 65485 | 65558 | 65630 | 65703 | 65775 | 65847 | 65920 | 65992 | 66064 | 66136 | 3 \| 44 |
| 39 | 66208 | 66280 | 66352 | 66424 | 66496 | 66567 | 66639 | 66710 | 66782 | 66853 | 66925 | 66996 | 4 \| 58 |
| 40 | 8.67067 | 67139 | 67209 | 67281 | 67352 | 67423 | 67494 | 67564 | 67635 | 67706 | 67777 | 67847 | s |
| 41 | 67918 | 67988 | 68059 | 68129 | 68199 | 68269 | 68340 | 68410 | 68480 | 68550 | 68620 | 68690 | 1 \| 14 |
| 42 | 68759 | 68829 | 68899 | 68969 | 69038 | 69108 | 69177 | 69247 | 69316 | 69385 | 69454 | 69524 | 2 \| 28 |
| 43 | 69593 | 69662 | 69731 | 69800 | 69869 | 69937 | 70006 | 70075 | 70144 | 70212 | 70281 | 70349 | 3 \| 42 |
| 44 | 70418 | 70486 | 70554 | 70623 | 70691 | 70759 | 70827 | 70895 | 70963 | 71031 | 71099 | 71167 | 4 \| 56 |
| 45 | 8.71234 | 71302 | 71370 | 71437 | 71505 | 71572 | 71640 | 71707 | 71774 | 71842 | 71909 | 71976 | s |
| 46 | 72043 | 72110 | 72177 | 72244 | 72311 | 72378 | 72444 | 72511 | 72578 | 72644 | 72711 | 72777 | 1 \| 13 |
| 47 | 72844 | 72910 | 72977 | 73043 | 73109 | 73175 | 73241 | 73308 | 73374 | 73439 | 73505 | 73571 | 2 \| 26 |
| 48 | 73637 | 73703 | 73768 | 73834 | 73900 | 73965 | 74031 | 74096 | 74162 | 74227 | 74292 | 74357 | 3 \| 40 |
| 49 | 74423 | 74488 | 74553 | 74618 | 74683 | 74748 | 74813 | 74877 | 74942 | 75007 | 75072 | 75136 | 4 \| 53 |
| 50 | 8.75201 | 75265 | 75330 | 75394 | 75458 | 75523 | 75587 | 75651 | 75715 | 75779 | 75843 | 75907 | s |
| 51 | 75971 | 76035 | 76099 | 76163 | 76227 | 76290 | 76354 | 76418 | 76481 | 76545 | 76608 | 76672 | 1 \| 13 |
| 52 | 76735 | 76798 | 76862 | 76925 | 76988 | 77051 | 77114 | 77177 | 77240 | 77303 | 77366 | 77429 | 2 \| 25 |
| 53 | 77492 | 77554 | 77617 | 77680 | 77742 | 77805 | 77867 | 77930 | 77992 | 78054 | 78117 | 78179 | 3 \| 38 |
| 54 | 78241 | 78303 | 78365 | 78427 | 78489 | 78551 | 78613 | 78675 | 78737 | 78799 | 78861 | 78922 | 4 \| 50 |
| 55 | 8.78984 | 79045 | 79107 | 79169 | 79230 | 79291 | 79353 | 79414 | 79475 | 79537 | 79598 | 79659 | s |
| 56 | 79720 | 79781 | 79842 | 79903 | 79964 | 80025 | 80085 | 80146 | 80207 | 80268 | 80328 | 80389 | 1 \| 12 |
| 57 | 80449 | 80510 | 80570 | 80631 | 80691 | 80751 | 80812 | 80872 | 80932 | 80992 | 81052 | 81112 | 2 \| 24 |
| 58 | 81172 | 81232 | 81292 | 81352 | 81412 | 81472 | 81531 | 81591 | 81651 | 81710 | 81770 | 81829 | 3 \| 36 |
| 59 | 81889 | 81948 | 82008 | 82067 | 82126 | 82186 | 82245 | 82304 | 82363 | 82422 | 82481 | 82540 | 4 \| 48 |

# TABLE XXXI.

## Logarithms for finding the Apparent Time or Horary Angle.

### 2 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.82599 | 82658 | 82717 | 82776 | 82835 | 82893 | 82952 | 83011 | 83069 | 83128 | 83187 | 83245 | s |
| 1 | 83303 | 83362 | 83420 | 83478 | 83537 | 83595 | 83653 | 83711 | 83769 | 83828 | 83885 | 83944 | 1 \| 11 |
| 2 | 84001 | 84059 | 84117 | 84175 | 84233 | 84291 | 84348 | 84406 | 84464 | 84521 | 84579 | 84636 | 2 \| 23 |
| 3 | 84694 | 84751 | 84808 | 84866 | 84923 | 84980 | 85037 | 85095 | 85152 | 85209 | 85266 | 85323 | 3 \| 34 |
| 4 | 85380 | 85437 | 85494 | 85550 | 85607 | 85664 | 85721 | 85777 | 85834 | 85891 | 85947 | 86004 | 4 \| 46 |
| 5 | 8.86060 | 86117 | 86173 | 86229 | 86286 | 86342 | 86398 | 86454 | 86511 | 86567 | 86623 | 86679 | s |
| 6 | 86735 | 86791 | 86847 | 86903 | 86959 | 87014 | 87070 | 87126 | 87182 | 87237 | 87293 | 87348 | 1 \| 11 |
| 7 | 87404 | 87460 | 87515 | 87570 | 87626 | 87681 | 87736 | 87792 | 87847 | 87902 | 87957 | 88013 | 2 \| 22 |
| 8 | 88068 | 88123 | 88178 | 88233 | 88288 | 88342 | 88397 | 88452 | 88507 | 88562 | 88616 | 88671 | 3 \| 33 |
| 9 | 88726 | 88780 | 88835 | 88889 | 88944 | 88998 | 89053 | 89107 | 89162 | 89216 | 89270 | 89324 | 4 \| 44 |
| 10 | 8.89379 | 89433 | 89487 | 89541 | 89595 | 89649 | 89703 | 89757 | 89811 | 89865 | 89918 | 89972 | s |
| 11 | 90026 | 90080 | 90133 | 90187 | 90241 | 90294 | 90348 | 90401 | 90455 | 90508 | 90562 | 90615 | 1 \| 11 |
| 12 | 90668 | 90722 | 90775 | 90828 | 90881 | 90934 | 90988 | 91041 | 91094 | 91147 | 91200 | 91253 | 2 \| 21 |
| 13 | 91306 | 91358 | 91411 | 91464 | 91517 | 91570 | 91622 | 91675 | 91728 | 91780 | 91833 | 91885 | 3 \| 32 |
| 14 | 91938 | 91990 | 92043 | 92095 | 92147 | 92200 | 92252 | 92304 | 92356 | 92408 | 92461 | 92513 | 4 \| 42 |
| 15 | 8.92565 | 92617 | 92669 | 92721 | 92773 | 92825 | 92877 | 92928 | 92980 | 93032 | 93084 | 93135 | s |
| 16 | 93187 | 93239 | 93290 | 93342 | 93393 | 93445 | 93496 | 93548 | 93599 | 93651 | 93702 | 93753 | 1 \| 10 |
| 17 | 93804 | 93856 | 93907 | 93958 | 94009 | 94060 | 94111 | 94162 | 94213 | 94264 | 94315 | 94366 | 2 \| 20 |
| 18 | 94417 | 94468 | 94519 | 94570 | 94620 | 94671 | 94722 | 94772 | 94823 | 94874 | 94924 | 94975 | 3 \| 31 |
| 19 | 95025 | 95075 | 95126 | 95176 | 95227 | 95277 | 95327 | 95378 | 95428 | 95478 | 95528 | 95578 | 4 \| 41 |
| 20 | 8.95628 | 95678 | 95728 | 95778 | 95828 | 95878 | 95928 | 95978 | 96028 | 96078 | 96128 | 96178 | s |
| 21 | 96227 | 96277 | 96326 | 96376 | 96426 | 96475 | 96525 | 96574 | 96624 | 96673 | 96723 | 96772 | 1 \| 10 |
| 22 | 96821 | 96871 | 96920 | 96969 | 97018 | 97068 | 97117 | 97166 | 97215 | 97264 | 97313 | 97362 | 2 \| 20 |
| 23 | 97411 | 97460 | 97509 | 97558 | 97607 | 97656 | 97704 | 97753 | 97802 | 97851 | 97899 | 97948 | 3 \| 29 |
| 24 | 97996 | 98045 | 98094 | 98142 | 98191 | 98239 | 98288 | 98336 | 98384 | 98433 | 98481 | 98529 | 4 \| 39 |
| 25 | 8.98578 | 98626 | 98674 | 98722 | 98770 | 98818 | 98866 | 98914 | 98963 | 99011 | 99058 | 99106 | s |
| 26 | 99154 | 99202 | 99250 | 99298 | 99346 | 99393 | 99441 | 99489 | 99536 | 99584 | 99632 | 99679 | 1 \| 10 |
| 27 | 9.99727 | 99774 | 99822 | 99869 | 99917 | 99964 | 00012 | 00059 | 00106 | 00154 | 00201 | 00248 | 2 \| 19 |
| 28 | 0.00295 | 00342 | 00390 | 00437 | 00484 | 00531 | 00578 | 00625 | 00672 | 00719 | 00766 | 00813 | 3 \| 29 |
| 29 | 00860 | 00906 | 00953 | 01000 | 01047 | 01094 | 01140 | 01187 | 01234 | 01280 | 01327 | 01373 | 4 \| 38 |
| 30 | 9.01420 | 01466 | 01513 | 01559 | 01606 | 01652 | 01698 | 01745 | 01791 | 01837 | 01884 | 01930 | s |
| 31 | 01976 | 02022 | 02068 | 02114 | 02161 | 02207 | 02253 | 02299 | 02345 | 02391 | 02437 | 02483 | 1 \| 9 |
| 32 | 02528 | 02574 | 02620 | 02666 | 02712 | 02757 | 02803 | 02849 | 02894 | 02940 | 02986 | 03031 | 2 \| 18 |
| 33 | 03077 | 03122 | 03168 | 03213 | 03259 | 03304 | 03350 | 03395 | 03440 | 03486 | 03531 | 03576 | 3 \| 28 |
| 34 | 03621 | 03667 | 03712 | 03757 | 03802 | 03847 | 03892 | 03937 | 03982 | 04027 | 04072 | 04117 | 4 \| 37 |
| 35 | 9.04162 | 04207 | 04252 | 04297 | 04341 | 04386 | 04431 | 04476 | 04520 | 04565 | 04610 | 04654 | s |
| 36 | 04699 | 04744 | 04788 | 04833 | 04877 | 04922 | 04966 | 05011 | 05055 | 05099 | 05144 | 05188 | 1 \| 9 |
| 37 | 05232 | 05277 | 05321 | 05365 | 05409 | 05453 | 05498 | 05542 | 05586 | 05630 | 05674 | 05718 | 2 \| 18 |
| 38 | 05762 | 05806 | 05850 | 05894 | 05938 | 05982 | 06025 | 06069 | 06113 | 06157 | 06200 | 06244 | 3 \| 27 |
| 39 | 06288 | 06332 | 06375 | 06419 | 06462 | 06506 | 06550 | 06593 | 06637 | 06680 | 06724 | 06767 | 4 \| 36 |
| 40 | 9.06810 | 06854 | 06897 | 06940 | 06984 | 07027 | 07070 | 07113 | 07157 | 07200 | 07243 | 07286 | s |
| 41 | 07329 | 07372 | 07415 | 07458 | 07501 | 07544 | 07587 | 07630 | 07673 | 07716 | 07759 | 07802 | 1 \| 9 |
| 42 | 07845 | 07887 | 07930 | 07973 | 08016 | 08058 | 08101 | 08144 | 08186 | 08229 | 08271 | 08314 | 2 \| 17 |
| 43 | 08357 | 08399 | 08442 | 08484 | 08526 | 08569 | 08611 | 08654 | 08696 | 08738 | 08781 | 08823 | 3 \| 26 |
| 44 | 08865 | 08907 | 08949 | 08992 | 09034 | 09076 | 09118 | 09160 | 09202 | 09244 | 09286 | 09328 | 4 \| 35 |
| 45 | 9.09370 | 09412 | 09454 | 09496 | 09538 | 09580 | 09622 | 09663 | 09705 | 09747 | 09789 | 09830 | s |
| 46 | 09872 | 09914 | 09955 | 09997 | 10039 | 10080 | 10122 | 10163 | 10205 | 10246 | 10288 | 10329 | 1 \| 8 |
| 47 | 10371 | 10412 | 10453 | 10495 | 10536 | 10577 | 10619 | 10660 | 10701 | 10742 | 10784 | 10825 | 2 \| 17 |
| 48 | 10866 | 10907 | 10948 | 10989 | 11030 | 11071 | 11112 | 11153 | 11194 | 11235 | 11276 | 11317 | 3 \| 25 |
| 49 | 11358 | 11399 | 11440 | 11480 | 11521 | 11562 | 11603 | 11643 | 11684 | 11725 | 11765 | 11806 | 4 \| 34 |
| 50 | 9.11847 | 11887 | 11928 | 11968 | 12009 | 12050 | 12090 | 12130 | 12171 | 12211 | 12252 | 12292 | s |
| 51 | 12332 | 12373 | 12413 | 12453 | 12494 | 12534 | 12574 | 12614 | 12655 | 12695 | 12735 | 12775 | 1 \| 8 |
| 52 | 12815 | 12855 | 12895 | 12935 | 12975 | 13015 | 13055 | 13095 | 13135 | 13175 | 13215 | 13255 | 2 \| 16 |
| 53 | 13295 | 13334 | 13374 | 13414 | 13454 | 13494 | 13533 | 13573 | 13613 | 13652 | 13692 | 13732 | 3 \| 24 |
| 54 | 13771 | 13811 | 13850 | 13890 | 13929 | 13969 | 14008 | 14048 | 14087 | 14126 | 14166 | 14205 | 4 \| 32 |
| 55 | 9.14245 | 14284 | 14323 | 14362 | 14402 | 14441 | 14480 | 14519 | 14559 | 14598 | 14637 | 14676 | s |
| 56 | 14715 | 14754 | 14793 | 14832 | 14871 | 14910 | 14949 | 14988 | 15027 | 15066 | 15105 | 15144 | 1 \| 8 |
| 57 | 15183 | 15221 | 15260 | 15299 | 15338 | 15377 | 15415 | 15454 | 15493 | 15531 | 15570 | 15609 | 2 \| 15 |
| 58 | 15647 | 15686 | 15724 | 15763 | 15802 | 15840 | 15879 | 15917 | 15955 | 15994 | 16032 | 16071 | 3 \| 23 |
| 59 | 16109 | 16147 | 16186 | 16224 | 16262 | 16301 | 16339 | 16377 | 16415 | 16453 | 16492 | 16530 | 4 \| 30 |

# TABLE XXXI.

## Logarithms for finding the Apparent Time or Horary Angle.

### 3 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.16568 | 16606 | 16644 | 16682 | 16720 | 16758 | 16796 | 16834 | 16872 | 16910 | 16948 | 16986 | s |
| 1 | 17024 | 17062 | 17100 | 17138 | 17175 | 17213 | 17251 | 17289 | 17326 | 17364 | 17402 | 17440 | 1 \| 7 |
| 2 | 17477 | 17515 | 17553 | 17590 | 17628 | 17665 | 17703 | 17740 | 17778 | 17815 | 17853 | 17890 | 2 \| 15 |
| 3 | 17928 | 17965 | 18003 | 18040 | 18077 | 18115 | 18152 | 18189 | 18227 | 18264 | 18301 | 18338 | 3 \| 22 |
| 4 | 18376 | 18413 | 18450 | 18487 | 18524 | 18561 | 18598 | 18636 | 18673 | 18710 | 18747 | 18784 | 4 \| 30 |
| 5 | 9.18821 | 18858 | 18895 | 18932 | 18968 | 19005 | 19042 | 19079 | 19116 | 19153 | 19190 | 19226 | s |
| 6 | 19263 | 19300 | 19337 | 19373 | 19410 | 19447 | 19483 | 19520 | 19557 | 19593 | 19630 | 19666 | 1 \| 7 |
| 7 | 19703 | 19739 | 19776 | 19812 | 19849 | 19885 | 19922 | 19958 | 19995 | 20031 | 20067 | 20104 | 2 \| 14 |
| 8 | 20140 | 20176 | 20213 | 20249 | 20285 | 20321 | 20358 | 20394 | 20430 | 20466 | 20502 | 20538 | 3 \| 22 |
| 9 | 20574 | 20611 | 20647 | 20683 | 20719 | 20755 | 20791 | 20827 | 20863 | 20899 | 20935 | 20970 | 4 \| 29 |
| 10 | 9.21006 | 21042 | 21078 | 21114 | 21150 | 21186 | 21221 | 21257 | 21293 | 21329 | 21364 | 21400 | s |
| 11 | 21436 | 21471 | 21507 | 21543 | 21578 | 21614 | 21650 | 21685 | 21721 | 21756 | 21792 | 21827 | 1 \| 7 |
| 12 | 21863 | 21898 | 21934 | 21969 | 22004 | 22040 | 22075 | 22111 | 22146 | 22181 | 22216 | 22252 | 2 \| 14 |
| 13 | 22287 | 22322 | 22358 | 22393 | 22428 | 22463 | 22498 | 22533 | 22569 | 22604 | 22639 | 22674 | 3 \| 21 |
| 14 | 22709 | 22744 | 22779 | 22814 | 22849 | 22884 | 22919 | 22954 | 22989 | 23024 | 23059 | 23094 | 4 \| 28 |
| 15 | 9.23128 | 23163 | 23198 | 23233 | 23268 | 23302 | 23337 | 23372 | 23407 | 23441 | 23476 | 23511 | s |
| 16 | 23545 | 23580 | 23615 | 23649 | 23684 | 23718 | 23753 | 23788 | 23822 | 23857 | 23891 | 23926 | 1 \| 7 |
| 17 | 23960 | 23994 | 24029 | 24063 | 24098 | 24132 | 24166 | 24201 | 24235 | 24269 | 24304 | 24338 | 2 \| 14 |
| 18 | 24372 | 24406 | 24441 | 24475 | 24509 | 24543 | 24577 | 24612 | 24646 | 24680 | 24714 | 24748 | 3 \| 20 |
| 19 | 24782 | 24816 | 24850 | 24884 | 24918 | 24952 | 24986 | 25020 | 25054 | 25088 | 25122 | 25156 | 4 \| 27 |
| 20 | 9.25190 | 25224 | 25257 | 25291 | 25325 | 25359 | 25393 | 25426 | 25460 | 25494 | 25527 | 25561 | s |
| 21 | 25595 | 25629 | 25662 | 25696 | 25729 | 25763 | 25796 | 25830 | 25864 | 25897 | 25931 | 25964 | 1 \| 7 |
| 22 | 25998 | 26031 | 26065 | 26098 | 26132 | 26165 | 26198 | 26232 | 26265 | 26298 | 26332 | 26365 | 2 \| 13 |
| 23 | 26398 | 26432 | 26465 | 26498 | 26532 | 26565 | 26598 | 26631 | 26664 | 26697 | 26731 | 26764 | 3 \| 20 |
| 24 | 26797 | 26830 | 26863 | 26896 | 26929 | 26962 | 26995 | 27028 | 27061 | 27094 | 27127 | 27160 | 4 \| 26 |
| 25 | 9.27193 | 27226 | 27259 | 27292 | 27325 | 27357 | 27390 | 27423 | 27456 | 27489 | 27521 | 27554 | s |
| 26 | 27587 | 27620 | 27652 | 27685 | 27718 | 27751 | 27783 | 27816 | 27848 | 27881 | 27914 | 27946 | 1 \| 6 |
| 27 | 27979 | 28011 | 28044 | 28076 | 28109 | 28141 | 28174 | 28206 | 28239 | 28271 | 28304 | 28336 | 2 \| 13 |
| 28 | 28368 | 28401 | 28433 | 28465 | 28498 | 28530 | 28562 | 28595 | 28627 | 28659 | 28691 | 28724 | 3 \| 19 |
| 29 | 28756 | 28788 | 28820 | 28852 | 28885 | 28917 | 28949 | 28981 | 29013 | 29045 | 29077 | 29109 | 4 \| 26 |
| 30 | 9.29141 | 29173 | 29205 | 29237 | 29269 | 29301 | 29333 | 29365 | 29397 | 29429 | 29461 | 29493 | s |
| 31 | 29524 | 29556 | 29588 | 29620 | 29652 | 29683 | 29715 | 29747 | 29779 | 29810 | 29842 | 29874 | 1 \| 6 |
| 32 | 29905 | 29937 | 29969 | 30000 | 30032 | 30064 | 30095 | 30127 | 30158 | 30190 | 30221 | 30253 | 2 \| 12 |
| 33 | 30285 | 30316 | 30347 | 30379 | 30410 | 30442 | 30473 | 30505 | 30536 | 30567 | 30599 | 30630 | 3 \| 18 |
| 34 | 30661 | 30693 | 30724 | 30755 | 30787 | 30818 | 30849 | 30880 | 30912 | 30943 | 30974 | 31005 | 4 \| 25 |
| 35 | 9.31036 | 31068 | 31099 | 31130 | 31161 | 31192 | 31223 | 31254 | 31285 | 31316 | 31347 | 31378 | s |
| 36 | 31409 | 31440 | 31471 | 31502 | 31533 | 31564 | 31595 | 31626 | 31657 | 31688 | 31719 | 31749 | 1 \| 6 |
| 37 | 31780 | 31811 | 31842 | 31873 | 31903 | 31934 | 31965 | 31996 | 32026 | 32057 | 32088 | 32119 | 2 \| 12 |
| 38 | 32149 | 32180 | 32210 | 32241 | 32272 | 32302 | 32333 | 32363 | 32394 | 32425 | 32455 | 32486 | 3 \| 18 |
| 39 | 32516 | 32547 | 32577 | 32608 | 32638 | 32668 | 32699 | 32729 | 32760 | 32790 | 32820 | 32851 | 4 \| 24 |
| 40 | 9.32881 | 32911 | 32942 | 32972 | 33002 | 33033 | 33063 | 33093 | 33123 | 33154 | 33184 | 33214 | s |
| 41 | 33244 | 33274 | 33304 | 33335 | 33365 | 33395 | 33425 | 33455 | 33485 | 33515 | 33545 | 33575 | 1 \| 6 |
| 42 | 33605 | 33635 | 33665 | 33695 | 33725 | 33755 | 33785 | 33815 | 33845 | 33875 | 33905 | 33935 | 2 \| 12 |
| 43 | 33965 | 33994 | 34024 | 34054 | 34084 | 34114 | 34143 | 34173 | 34203 | 34233 | 34262 | 34292 | 3 \| 18 |
| 44 | 34322 | 34352 | 34381 | 34411 | 34441 | 34470 | 34500 | 34529 | 34559 | 34589 | 34618 | 34648 | 4 \| 24 |
| 45 | 9.34677 | 34707 | 34736 | 34766 | 34795 | 34825 | 34854 | 34884 | 34913 | 34943 | 34972 | 35002 | s |
| 46 | 35031 | 35060 | 35090 | 35119 | 35148 | 35178 | 35207 | 35236 | 35265 | 35295 | 35324 | 35353 | 1 \| 6 |
| 47 | 35383 | 35412 | 35441 | 35470 | 35499 | 35529 | 35558 | 35587 | 35616 | 35645 | 35674 | 35703 | 2 \| 12 |
| 48 | 35733 | 35762 | 35791 | 35820 | 35849 | 35878 | 35907 | 35936 | 35965 | 35994 | 36023 | 36052 | 3 \| 17 |
| 49 | 36081 | 36110 | 36139 | 36167 | 36196 | 36225 | 36254 | 36283 | 36312 | 36341 | 36369 | 36398 | 4 \| 23 |
| 50 | 9.36427 | 36456 | 36485 | 36513 | 36542 | 36571 | 36599 | 36628 | 36657 | 36686 | 36714 | 36743 | s |
| 51 | 36771 | 36800 | 36829 | 36857 | 36886 | 36915 | 36943 | 36972 | 37000 | 37029 | 37057 | 37086 | 1 \| 6 |
| 52 | 37114 | 37143 | 37171 | 37200 | 37228 | 37257 | 37285 | 37313 | 37342 | 37370 | 37399 | 37427 | 2 \| 11 |
| 53 | 37455 | 37484 | 37512 | 37540 | 37568 | 37597 | 37625 | 37653 | 37682 | 37710 | 37738 | 37766 | 3 \| 17 |
| 54 | 37794 | 37823 | 37851 | 37879 | 37907 | 37935 | 37963 | 37991 | 38020 | 38048 | 38076 | 38104 | 4 \| 23 |
| 55 | 9.38132 | 38160 | 38188 | 38216 | 38244 | 38272 | 38300 | 38328 | 38356 | 38384 | 38412 | 38440 | s |
| 56 | 38468 | 38496 | 38524 | 38551 | 38579 | 38607 | 38635 | 38663 | 38691 | 38718 | 38746 | 38774 | 1 \| 6 |
| 57 | 38802 | 38830 | 38857 | 38885 | 38913 | 38940 | 38968 | 38996 | 39024 | 39051 | 39079 | 39107 | 2 \| 11 |
| 58 | 39134 | 39162 | 39189 | 39217 | 39245 | 39272 | 39300 | 39327 | 39355 | 39382 | 39410 | 39437 | 3 \| 17 |
| 59 | 39465 | 39492 | 39520 | 39547 | 39575 | 39602 | 39630 | 39657 | 39684 | 39712 | 39739 | 39767 | 4 \| 22 |

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

## 4 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.39794 | 39821 | 39849 | 39876 | 39903 | 39931 | 39958 | 39985 | 40012 | 40040 | 40067 | 40094 | s |
| 1 | 40121 | 40149 | 40176 | 40203 | 40230 | 40257 | 40284 | 40312 | 40339 | 40366 | 40393 | 40420 | 1 \| 5 |
| 2 | 40447 | 40474 | 40501 | 40528 | 40555 | 40582 | 40609 | 40636 | 40663 | 40690 | 40717 | 40744 | 2 \| 11 |
| 3 | 40771 | 40798 | 40825 | 40852 | 40879 | 40906 | 40933 | 40960 | 40986 | 41013 | 41040 | 41067 | 3 \| 16 |
| 4 | 41094 | 41121 | 41147 | 41174 | 41201 | 41228 | 41254 | 41281 | 41308 | 41335 | 41361 | 41388 | 4 \| 22 |
| 5 | 9.41415 | 41441 | 41468 | 41495 | 41521 | 41548 | 41575 | 41601 | 41628 | 41654 | 41681 | 41707 | s |
| 6 | 41734 | 41761 | 41787 | 41814 | 41840 | 41867 | 41893 | 41920 | 41946 | 41972 | 41999 | 42025 | 1 \| 5 |
| 7 | 42052 | 42078 | 42105 | 42131 | 42157 | 42184 | 42210 | 42236 | 42263 | 42289 | 42315 | 42342 | 2 \| 10 |
| 8 | 42368 | 42394 | 42420 | 42447 | 42473 | 42499 | 42525 | 42552 | 42578 | 42604 | 42630 | 42656 | 3 \| 16 |
| 9 | 42682 | 42709 | 42735 | 42761 | 42787 | 42813 | 42839 | 42865 | 42891 | 42917 | 42943 | 42969 | 4 \| 21 |
| 10 | 9.42996 | 43022 | 43048 | 43074 | 43100 | 43125 | 43151 | 43177 | 43203 | 43229 | 43255 | 43281 | s |
| 11 | 43307 | 43333 | 43359 | 43385 | 43411 | 43436 | 43462 | 43488 | 43514 | 43540 | 43565 | 43591 | 1 \| 5 |
| 12 | 43617 | 43643 | 43669 | 43694 | 43720 | 43746 | 43771 | 43797 | 43823 | 43848 | 43874 | 43900 | 2 \| 10 |
| 13 | 43925 | 43951 | 43977 | 44002 | 44028 | 44054 | 44079 | 44105 | 44130 | 44156 | 44181 | 44207 | 3 \| 15 |
| 14 | 44232 | 44258 | 44283 | 44309 | 44334 | 44360 | 44385 | 44411 | 44436 | 44462 | 44487 | 44513 | 4 \| 20 |
| 15 | 9.44538 | 44563 | 44589 | 44614 | 44639 | 44665 | 44690 | 44715 | 44741 | 44766 | 44791 | 44817 | s |
| 16 | 44842 | 44867 | 44892 | 44918 | 44943 | 44968 | 44993 | 45019 | 45044 | 45069 | 45094 | 45119 | 1 \| 5 |
| 17 | 45144 | 45170 | 45195 | 45220 | 45245 | 45270 | 45295 | 45320 | 45345 | 45370 | 45395 | 45420 | 2 \| 10 |
| 18 | 45446 | 45471 | 45496 | 45521 | 45546 | 45571 | 45595 | 45620 | 45645 | 45670 | 45695 | 45720 | 3 \| 15 |
| 19 | 45745 | 45770 | 45795 | 45820 | 45845 | 45870 | 45894 | 45919 | 45944 | 45969 | 45994 | 46018 | 4 \| 20 |
| 20 | 9.46043 | 46068 | 46093 | 46118 | 46142 | 46167 | 46192 | 46217 | 46241 | 46266 | 46291 | 46315 | s |
| 21 | 46340 | 46365 | 46389 | 46414 | 46439 | 46463 | 46488 | 46512 | 46537 | 46562 | 46586 | 46611 | 1 \| 5 |
| 22 | 46635 | 46660 | 46684 | 46709 | 46733 | 46758 | 46782 | 46807 | 46831 | 46856 | 46880 | 46905 | 2 \| 10 |
| 23 | 46929 | 46954 | 46978 | 47002 | 47027 | 47051 | 47076 | 47100 | 47124 | 47149 | 47173 | 47197 | 3 \| 15 |
| 24 | 47222 | 47246 | 47270 | 47295 | 47319 | 47343 | 47367 | 47392 | 47416 | 47440 | 47464 | 47489 | 4 \| 20 |
| 25 | 9.47513 | 47537 | 47561 | 47585 | 47610 | 47634 | 47658 | 47682 | 47706 | 47730 | 47754 | 47779 | s |
| 26 | 47803 | 47827 | 47851 | 47875 | 47899 | 47923 | 47947 | 47971 | 47995 | 48019 | 48043 | 48067 | 1 \| 5 |
| 27 | 48091 | 48115 | 48139 | 48163 | 48187 | 48211 | 48235 | 48258 | 48282 | 48306 | 48330 | 48354 | 2 \| 10 |
| 28 | 48378 | 48402 | 48426 | 48449 | 48473 | 48497 | 48521 | 48545 | 48568 | 48592 | 48616 | 48640 | 3 \| 14 |
| 29 | 48664 | 48687 | 48711 | 48735 | 48758 | 48782 | 48806 | 48830 | 48853 | 48877 | 48900 | 48924 | 4 \| 19 |
| 30 | 9.48948 | 48971 | 48995 | 49019 | 49042 | 49066 | 49089 | 49113 | 49137 | 49160 | 49184 | 49207 | s |
| 31 | 49231 | 49254 | 49278 | 49301 | 49325 | 49348 | 49372 | 49395 | 49419 | 49442 | 49465 | 49489 | 1 \| 5 |
| 32 | 49512 | 49536 | 49559 | 49583 | 49606 | 49629 | 49653 | 49676 | 49699 | 49723 | 49746 | 49769 | 2 \| 9 |
| 33 | 49793 | 49816 | 49839 | 49862 | 49886 | 49909 | 49932 | 49956 | 49979 | 50002 | 50025 | 50048 | 3 \| 14 |
| 34 | 50071 | 50095 | 50118 | 50141 | 50164 | 50187 | 50211 | 50234 | 50257 | 50280 | 50303 | 50326 | 4 \| 19 |
| 35 | 9.50349 | 50372 | 50395 | 50418 | 50441 | 50465 | 50488 | 50511 | 50534 | 50557 | 50580 | 50603 | s |
| 36 | 50626 | 50649 | 50672 | 50694 | 50717 | 50740 | 50763 | 50786 | 50809 | 50832 | 50855 | 50878 | 1 \| 5 |
| 37 | 50901 | 50924 | 50946 | 50969 | 50992 | 51015 | 51038 | 51060 | 51083 | 51106 | 51129 | 51152 | 2 \| 9 |
| 38 | 51174 | 51197 | 51220 | 51243 | 51265 | 51288 | 51311 | 51334 | 51356 | 51379 | 51402 | 51424 | 3 \| 14 |
| 39 | 51447 | 51470 | 51492 | 51515 | 51538 | 51560 | 51583 | 51605 | 51628 | 51651 | 51673 | 51696 | 4 \| 18 |
| 40 | 9.51718 | 51741 | 51763 | 51786 | 51808 | 51831 | 51853 | 51876 | 51898 | 51921 | 51943 | 51966 | s |
| 41 | 51988 | 52011 | 52033 | 52056 | 52078 | 52100 | 52123 | 52145 | 52168 | 52190 | 52212 | 52235 | 1 \| 4 |
| 42 | 52257 | 52279 | 52302 | 52324 | 52346 | 52369 | 52391 | 52413 | 52435 | 52458 | 52480 | 52502 | 2 \| 9 |
| 43 | 52525 | 52547 | 52569 | 52591 | 52613 | 52636 | 52658 | 52680 | 52702 | 52724 | 52747 | 52769 | 3 \| 13 |
| 44 | 52791 | 52813 | 52835 | 52857 | 52879 | 52901 | 52923 | 52946 | 52968 | 52990 | 53012 | 53034 | 4 \| 18 |
| 45 | 9.53056 | 53078 | 53100 | 53122 | 53144 | 53166 | 53188 | 53210 | 53232 | 53254 | 53276 | 53298 | s |
| 46 | 53320 | 53342 | 53364 | 53385 | 53407 | 53429 | 53451 | 53473 | 53495 | 53517 | 53539 | 53560 | 1 \| 4 |
| 47 | 53582 | 53604 | 53626 | 53648 | 53670 | 53691 | 53713 | 53735 | 53757 | 53778 | 53800 | 53822 | 2 \| 9 |
| 48 | 53844 | 53865 | 53887 | 53909 | 53931 | 53952 | 53974 | 53996 | 54017 | 54039 | 54061 | 54082 | 3 \| 13 |
| 49 | 54104 | 54126 | 54147 | 54169 | 54190 | 54212 | 54234 | 54255 | 54277 | 54298 | 54320 | 54341 | 4 \| 18 |
| 50 | 9.54363 | 54385 | 54406 | 54428 | 54449 | 54471 | 54492 | 54514 | 54535 | 54556 | 54578 | 54599 | s |
| 51 | 54621 | 54642 | 54664 | 54685 | 54707 | 54728 | 54749 | 54771 | 54792 | 54813 | 54835 | 54856 | 1 \| 4 |
| 52 | 54878 | 54899 | 54920 | 54941 | 54963 | 54984 | 55005 | 55027 | 55048 | 55069 | 55091 | 55112 | 2 \| 9 |
| 53 | 55133 | 55154 | 55175 | 55197 | 55218 | 55239 | 55260 | 55282 | 55303 | 55324 | 55345 | 55366 | 3 \| 13 |
| 54 | 55387 | 55409 | 55430 | 55451 | 55472 | 55493 | 55514 | 55535 | 55556 | 55577 | 55598 | 55619 | 4 \| 17 |
| 55 | 9.55641 | 55662 | 55683 | 55704 | 55725 | 55746 | 55767 | 55788 | 55809 | 55830 | 55851 | 55872 | s |
| 56 | 55893 | 55914 | 55934 | 55955 | 55976 | 55997 | 56018 | 56039 | 56060 | 56081 | 56102 | 56123 | 1 \| 4 |
| 57 | 56144 | 56164 | 56185 | 56206 | 56227 | 56248 | 56269 | 56289 | 56310 | 56331 | 56352 | 56372 | 2 \| 8 |
| 58 | 56393 | 56414 | 56435 | 56456 | 56476 | 56497 | 56518 | 56538 | 56559 | 56580 | 56601 | 56621 | 3 \| 13 |
| 59 | 56642 | 56663 | 56683 | 56704 | 56725 | 56745 | 56766 | 56786 | 56807 | 56828 | 56848 | 56869 | 4 \| 17 |

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

5 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.56889 | 56910 | 56931 | 56951 | 56972 | 56992 | 57013 | 57033 | 57054 | 57074 | 57095 | 57115 | s |
| 1 | 57136 | 57156 | 57177 | 57197 | 57218 | 57238 | 57259 | 57279 | 57299 | 57320 | 57340 | 57361 | 1 \| 4 |
| 2 | 57381 | 57402 | 57422 | 57442 | 57463 | 57483 | 57503 | 57524 | 57544 | 57564 | 57585 | 57605 | 2 \| 8 |
| 3 | 57625 | 57646 | 57666 | 57686 | 57706 | 57727 | 57747 | 57767 | 57787 | 57808 | 57828 | 57848 | 3 \| 12 |
| 4 | 57868 | 57889 | 57909 | 57929 | 57949 | 57969 | 57990 | 58010 | 58030 | 58050 | 58070 | 58090 | 4 \| 16 |
| 5 | 9.58110 | 58131 | 58151 | 58171 | 58191 | 58211 | 58231 | 58251 | 58271 | 58291 | 58311 | 58331 | s |
| 6 | 58351 | 58371 | 58391 | 58411 | 58431 | 58451 | 58471 | 58491 | 58511 | 58531 | 58551 | 58571 | 1 \| 4 |
| 7 | 58591 | 58611 | 58631 | 58651 | 58671 | 58691 | 58711 | 58731 | 58750 | 58770 | 58790 | 58810 | 2 \| 8 |
| 8 | 58830 | 58850 | 58870 | 58889 | 58909 | 58929 | 58949 | 58969 | 58988 | 59008 | 59028 | 59048 | 3 \| 12 |
| 9 | 59068 | 59087 | 59107 | 59127 | 59147 | 59166 | 59186 | 59206 | 59225 | 59245 | 59265 | 59285 | 4 \| 16 |
| 10 | 9.59304 | 59324 | 59344 | 59363 | 59383 | 59403 | 59422 | 59442 | 59461 | 59481 | 59501 | 59520 | s |
| 11 | 59540 | 59559 | 59579 | 59599 | 59618 | 59638 | 59657 | 59677 | 59696 | 59716 | 59735 | 59755 | 1 \| 4 |
| 12 | 59774 | 59794 | 59813 | 59833 | 59852 | 59872 | 59891 | 59911 | 59930 | 59950 | 59969 | 59988 | 2 \| 8 |
| 13 | 60008 | 60027 | 60047 | 60066 | 60085 | 60105 | 60124 | 60144 | 60163 | 60182 | 60202 | 60221 | 3 \| 12 |
| 14 | 60240 | 60260 | 60279 | 60298 | 60318 | 60337 | 60356 | 60375 | 60395 | 60414 | 60433 | 60452 | 4 \| 16 |
| 15 | 9.60472 | 60491 | 60510 | 60529 | 60549 | 60568 | 60587 | 60606 | 60625 | 60645 | 60664 | 60683 | s |
| 16 | 60702 | 60721 | 60740 | 60760 | 60779 | 60798 | 60817 | 60836 | 60855 | 60874 | 60893 | 60912 | 1 \| 4 |
| 17 | 60931 | 60951 | 60970 | 60989 | 61008 | 61027 | 61046 | 61065 | 61084 | 61103 | 61122 | 61141 | 2 \| 8 |
| 18 | 61160 | 61179 | 61198 | 61217 | 61236 | 61255 | 61274 | 61293 | 61311 | 61330 | 61349 | 61368 | 3 \| 11 |
| 19 | 61387 | 61406 | 61425 | 61444 | 61463 | 61482 | 61500 | 61519 | 61538 | 61557 | 61576 | 61595 | 4 \| 15 |
| 20 | 9.61613 | 61632 | 61651 | 61670 | 61689 | 61708 | 61726 | 61745 | 61764 | 61783 | 61801 | 61820 | s |
| 21 | 61839 | 61858 | 61876 | 61895 | 61914 | 61932 | 61951 | 61970 | 61988 | 62007 | 62026 | 62045 | 1 \| 4 |
| 22 | 62063 | 62082 | 62100 | 62119 | 62138 | 62156 | 62175 | 62194 | 62212 | 62231 | 62249 | 62268 | 2 \| 7 |
| 23 | 62287 | 62305 | 62324 | 62342 | 62361 | 62379 | 62398 | 62416 | 62435 | 62453 | 62472 | 62490 | 3 \| 11 |
| 24 | 62509 | 62527 | 62546 | 62564 | 62583 | 62601 | 62620 | 62638 | 62657 | 62675 | 62693 | 62712 | 4 \| 15 |
| 25 | 9.62730 | 62749 | 62767 | 62785 | 62804 | 62822 | 62841 | 62859 | 62877 | 62896 | 62914 | 62932 | s |
| 26 | 62951 | 62969 | 62987 | 63006 | 63024 | 63042 | 63061 | 63079 | 63097 | 63115 | 63134 | 63152 | 1 \| 4 |
| 27 | 63170 | 63188 | 63207 | 63225 | 63243 | 63261 | 63279 | 63298 | 63316 | 63334 | 63352 | 63370 | 2 \| 7 |
| 28 | 63389 | 63407 | 63425 | 63443 | 63461 | 63479 | 63497 | 63516 | 63534 | 63552 | 63570 | 63588 | 3 \| 11 |
| 29 | 63606 | 63624 | 63642 | 63660 | 63678 | 63696 | 63715 | 63733 | 63751 | 63769 | 63787 | 63805 | 4 \| 15 |
| 30 | 9.63823 | 63841 | 63859 | 63877 | 63895 | 63913 | 63931 | 63949 | 63966 | 63985 | 64002 | 64020 | s |
| 31 | 64038 | 64056 | 64074 | 64092 | 64110 | 64128 | 64146 | 64164 | 64181 | 64199 | 64217 | 64235 | 1 \| 4 |
| 32 | 64253 | 64271 | 64289 | 64307 | 64324 | 64342 | 64360 | 64378 | 64395 | 64413 | 64431 | 64449 | 2 \| 7 |
| 33 | 64467 | 64484 | 64502 | 64520 | 64538 | 64555 | 64573 | 64591 | 64609 | 64626 | 64644 | 64662 | 3 \| 11 |
| 34 | 64679 | 64697 | 64715 | 64732 | 64750 | 64768 | 64785 | 64803 | 64821 | 64838 | 64856 | 64873 | 4 \| 14 |
| 35 | 9.64891 | 64909 | 64926 | 64944 | 64962 | 64979 | 64997 | 65014 | 65032 | 65050 | 65067 | 65085 | s |
| 36 | 65102 | 65120 | 65137 | 65155 | 65172 | 65190 | 65207 | 65225 | 65242 | 65260 | 65277 | 65295 | 1 \| 3 |
| 37 | 65312 | 65330 | 65347 | 65365 | 65382 | 65399 | 65417 | 65434 | 65452 | 65469 | 65486 | 65504 | 2 \| 7 |
| 38 | 65521 | 65539 | 65556 | 65573 | 65591 | 65608 | 65625 | 65643 | 65660 | 65677 | 65695 | 65712 | 3 \| 10 |
| 39 | 65729 | 65747 | 65764 | 65781 | 65799 | 65816 | 65834 | 65850 | 65868 | 65885 | 65902 | 65919 | 4 \| 14 |
| 40 | 9.65937 | 65954 | 65971 | 65988 | 66006 | 66023 | 66040 | 66057 | 66074 | 66092 | 66109 | 66126 | s |
| 41 | 66143 | 66160 | 66177 | 66194 | 66212 | 66229 | 66246 | 66263 | 66280 | 66297 | 66314 | 66331 | 1 \| 3 |
| 42 | 66348 | 66366 | 66383 | 66400 | 66417 | 66434 | 66451 | 66468 | 66485 | 66492 | 66519 | 66536 | 2 \| 7 |
| 43 | 66553 | 66570 | 66587 | 66604 | 66621 | 66638 | 66655 | 66672 | 66689 | 66706 | 66723 | 66740 | 3 \| 10 |
| 44 | 66757 | 66774 | 66791 | 66807 | 66824 | 66841 | 66858 | 66875 | 66892 | 66909 | 66926 | 66943 | 4 \| 14 |
| 45 | 9.66959 | 66976 | 66993 | 67010 | 67027 | 67044 | 67060 | 67077 | 67094 | 67111 | 67128 | 67144 | s |
| 46 | 67161 | 67178 | 67195 | 67212 | 67228 | 67245 | 67262 | 67279 | 67295 | 67312 | 67329 | 67346 | 1 \| 3 |
| 47 | 67362 | 67379 | 67396 | 67412 | 67429 | 67446 | 67462 | 67479 | 67496 | 67512 | 67529 | 67546 | 2 \| 7 |
| 48 | 67562 | 67579 | 67596 | 67612 | 67629 | 67646 | 67662 | 67679 | 67695 | 67712 | 67729 | 67745 | 3 \| 10 |
| 49 | 67762 | 67778 | 67795 | 67811 | 67828 | 67844 | 67861 | 67878 | 67894 | 67911 | 67927 | 67944 | 4 \| 13 |
| 50 | 9.67960 | 67977 | 67993 | 68010 | 68026 | 68042 | 68059 | 68075 | 68092 | 68108 | 68125 | 68141 | s |
| 51 | 68158 | 68174 | 68190 | 68207 | 68223 | 68240 | 68256 | 68272 | 68289 | 68305 | 68322 | 68338 | 1 \| 3 |
| 52 | 68354 | 68371 | 68387 | 68403 | 68420 | 68436 | 68452 | 68469 | 68485 | 68501 | 68517 | 68534 | 2 \| 7 |
| 53 | 68550 | 68566 | 68583 | 68599 | 68615 | 68631 | 68648 | 68664 | 68680 | 68696 | 68713 | 68729 | 3 \| 10 |
| 54 | 68745 | 68761 | 68777 | 68794 | 68810 | 68826 | 68842 | 68858 | 68874 | 68891 | 68907 | 68923 | 4 \| 13 |
| 55 | 9.68939 | 68955 | 68971 | 68987 | 69004 | 69020 | 69036 | 69052 | 69068 | 69084 | 69100 | 69116 | s |
| 56 | 69132 | 69148 | 69164 | 69181 | 69197 | 69213 | 69229 | 69245 | 69261 | 69277 | 69293 | 69309 | 1 \| 3 |
| 57 | 69325 | 69341 | 69357 | 69373 | 69389 | 69405 | 69421 | 69437 | 69453 | 69469 | 69484 | 69500 | 2 \| 6 |
| 58 | 69516 | 69532 | 69548 | 69564 | 69580 | 69596 | 69612 | 69628 | 69644 | 69660 | 69675 | 69691 | 3 \| 10 |
| 59 | 69707 | 69723 | 69739 | 69755 | 69770 | 69786 | 69802 | 69818 | 69834 | 69850 | 69866 | 69881 | 4 \| 13 |

# TABLE XXXI.

## Logarithms for finding the Apparent Time or Horary Angle.

### 6 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.69897 | 69913 | 69929 | 69944 | 69960 | 69976 | 69992 | 70007 | 70023 | 70039 | 70055 | 70070 | s |
| 1 | 70086 | 70102 | 70118 | 70133 | 70149 | 70165 | 70180 | 70196 | 70211 | 70227 | 70243 | 70259 | 1 \| 3 |
| 2 | 70274 | 70290 | 70306 | 70321 | 70337 | 70353 | 70368 | 70384 | 70399 | 70415 | 70431 | 70446 | 2 \| 6 |
| 3 | 70462 | 70477 | 70493 | 70509 | 70524 | 70540 | 70555 | 70571 | 70586 | 70602 | 70617 | 70633 | 3 \| 9 |
| 4 | 70648 | 70664 | 70680 | 70695 | 70710 | 70726 | 70741 | 70757 | 70772 | 70788 | 70803 | 70819 | 4 \| 12 |
| 5 | 9.70834 | 70850 | 70865 | 70881 | 70896 | 70911 | 70927 | 70942 | 70958 | 70973 | 70988 | 71004 | s |
| 6 | 71019 | 71035 | 71050 | 71065 | 71081 | 71096 | 71111 | 71127 | 71142 | 71157 | 71173 | 71188 | 1 \| 3 |
| 7 | 71203 | 71219 | 71234 | 71249 | 71265 | 71280 | 71295 | 71310 | 71326 | 71341 | 71356 | 71371 | 2 \| 6 |
| 8 | 71387 | 71402 | 71417 | 71433 | 71448 | 71463 | 71478 | 71493 | 71509 | 71524 | 71539 | 71554 | 3 \| 9 |
| 9 | 71569 | 71585 | 71600 | 71615 | 71630 | 71645 | 71660 | 71676 | 71691 | 71706 | 71721 | 71736 | 4 \| 12 |
| 10 | 9.71751 | 71766 | 71781 | 71797 | 71812 | 71827 | 71842 | 71857 | 71872 | 71887 | 71902 | 71917 | s |
| 11 | 71932 | 71947 | 71962 | 71977 | 71992 | 72007 | 72022 | 72037 | 72052 | 72067 | 72082 | 72097 | 1 \| 3 |
| 12 | 72112 | 72127 | 72142 | 72157 | 72172 | 72187 | 72202 | 72217 | 72232 | 72247 | 72262 | 72277 | 2 \| 6 |
| 13 | 72292 | 72307 | 72322 | 72337 | 72352 | 72366 | 72381 | 72396 | 72411 | 72426 | 72441 | 72456 | 3 \| 9 |
| 14 | 72471 | 72485 | 72500 | 72515 | 72530 | 72545 | 72560 | 72574 | 72589 | 72604 | 72619 | 72634 | 4 \| 12 |
| 15 | 9.72648 | 72663 | 72678 | 72693 | 72708 | 72722 | 72737 | 72752 | 72767 | 72781 | 72796 | 72811 | s |
| 16 | 72825 | 72840 | 72855 | 72870 | 72884 | 72899 | 72914 | 72928 | 72943 | 72958 | 72972 | 72987 | 1 \| 3 |
| 17 | 73002 | 73016 | 73031 | 73046 | 73060 | 73075 | 73090 | 73104 | 73119 | 73134 | 73148 | 73163 | 2 \| 6 |
| 18 | 73177 | 73192 | 73207 | 73221 | 73236 | 73250 | 73265 | 73279 | 73294 | 73309 | 73323 | 73338 | 3 \| 9 |
| 19 | 73352 | 73367 | 73381 | 73396 | 73410 | 73425 | 73439 | 73454 | 73468 | 73483 | 73497 | 73512 | 4 \| 12 |
| 20 | 9.73526 | 73541 | 73555 | 73569 | 73584 | 73598 | 73613 | 73627 | 73642 | 73656 | 73671 | 73685 | s |
| 21 | 73699 | 73714 | 73728 | 73743 | 73757 | 73771 | 73786 | 73800 | 73815 | 73829 | 73843 | 73858 | 1 \| 3 |
| 22 | 73872 | 73886 | 73901 | 73915 | 73929 | 73944 | 73958 | 73972 | 73987 | 74001 | 74015 | 74029 | 2 \| 6 |
| 23 | 74044 | 74058 | 74072 | 74087 | 74101 | 74115 | 74129 | 74144 | 74158 | 74172 | 74186 | 74200 | 3 \| 9 |
| 24 | 74215 | 74229 | 74243 | 74257 | 74272 | 74286 | 74300 | 74314 | 74328 | 74342 | 74357 | 74371 | 4 \| 12 |
| 25 | 9.74385 | 74399 | 74413 | 74427 | 74442 | 74456 | 74470 | 74484 | 74498 | 74512 | 74526 | 74540 | s |
| 26 | 74554 | 74569 | 74583 | 74597 | 74611 | 74625 | 74639 | 74653 | 74667 | 74681 | 74695 | 74709 | 1 \| 3 |
| 27 | 74723 | 74737 | 74751 | 74765 | 74779 | 74793 | 74807 | 74821 | 74835 | 74849 | 74863 | 74877 | 2 \| 5 |
| 28 | 74891 | 74905 | 74919 | 74933 | 74947 | 74961 | 74975 | 74989 | 75003 | 75017 | 75031 | 75045 | 3 \| 8 |
| 29 | 75059 | 75072 | 75086 | 75100 | 75114 | 75128 | 75142 | 75156 | 75170 | 75183 | 75197 | 75211 | 4 \| 11 |
| 30 | 9.75225 | 75239 | 75253 | 75267 | 75280 | 75294 | 75308 | 75322 | 75336 | 75349 | 75363 | 75377 | s |
| 31 | 75391 | 75405 | 75418 | 75432 | 75446 | 75460 | 75474 | 75487 | 75501 | 75515 | 75528 | 75542 | 1 \| 3 |
| 32 | 75556 | 75570 | 75583 | 75597 | 75611 | 75625 | 75638 | 75652 | 75666 | 75679 | 75693 | 75707 | 2 \| 5 |
| 33 | 75720 | 75734 | 75748 | 75761 | 75775 | 75789 | 75802 | 75816 | 75830 | 75843 | 75857 | 75870 | 3 \| 8 |
| 34 | 75884 | 75898 | 75911 | 75925 | 75938 | 75952 | 75966 | 75979 | 75993 | 76006 | 76020 | 76033 | 4 \| 10 |
| 35 | 9.76047 | 76060 | 76074 | 76088 | 76101 | 76115 | 76128 | 76142 | 76155 | 76169 | 76182 | 76196 | s |
| 36 | 76209 | 76223 | 76236 | 76250 | 76263 | 76276 | 76290 | 76303 | 76317 | 76330 | 76344 | 76357 | 1 \| 3 |
| 37 | 76371 | 76384 | 76397 | 76411 | 76424 | 76438 | 76451 | 76464 | 76478 | 76491 | 76505 | 76518 | 2 \| 5 |
| 38 | 76531 | 76545 | 76558 | 76571 | 76585 | 76598 | 76611 | 76625 | 76638 | 76651 | 76665 | 76678 | 3 \| 8 |
| 39 | 76691 | 76705 | 76718 | 76731 | 76745 | 76758 | 76771 | 76784 | 76798 | 76811 | 76824 | 76838 | 4 \| 10 |
| 40 | 9.76851 | 76864 | 76877 | 76891 | 76904 | 76917 | 76930 | 76943 | 76957 | 76970 | 76983 | 76996 | s |
| 41 | 77009 | 77023 | 77036 | 77049 | 77062 | 77075 | 77089 | 77102 | 77115 | 77128 | 77141 | 77154 | 1 \| 3 |
| 42 | 77167 | 77181 | 77194 | 77207 | 77220 | 77233 | 77246 | 77259 | 77272 | 77285 | 77298 | 77312 | 2 \| 5 |
| 43 | 77325 | 77338 | 77351 | 77364 | 77377 | 77390 | 77403 | 77416 | 77429 | 77442 | 77455 | 77468 | 3 \| 8 |
| 44 | 77481 | 77494 | 77507 | 77520 | 77533 | 77546 | 77559 | 77572 | 77585 | 77598 | 77611 | 77624 | 4 \| 10 |
| 45 | 9.77637 | 77650 | 77663 | 77676 | 77689 | 77702 | 77715 | 77728 | 77741 | 77754 | 77766 | 77779 | s |
| 46 | 77792 | 77805 | 77818 | 77831 | 77844 | 77857 | 77870 | 77882 | 77895 | 77908 | 77921 | 77934 | 1 \| 3 |
| 47 | 77947 | 77960 | 77972 | 77985 | 77998 | 78011 | 78024 | 78037 | 78049 | 78062 | 78075 | 78088 | 2 \| 5 |
| 48 | 78101 | 78113 | 78126 | 78139 | 78152 | 78164 | 78177 | 78190 | 78203 | 78215 | 78228 | 78241 | 3 \| 8 |
| 49 | 78254 | 78266 | 78279 | 78292 | 78305 | 78317 | 78330 | 78343 | 78355 | 78368 | 78381 | 78393 | 4 \| 10 |
| 50 | 9.78406 | 78419 | 78431 | 78444 | 78457 | 78469 | 78482 | 78495 | 78507 | 78520 | 78533 | 78545 | s |
| 51 | 78558 | 78570 | 78583 | 78596 | 78608 | 78621 | 78633 | 78646 | 78659 | 78671 | 78684 | 78696 | 1 \| 2 |
| 52 | 78709 | 78721 | 78734 | 78747 | 78759 | 78772 | 78784 | 78797 | 78809 | 78822 | 78834 | 78847 | 2 \| 5 |
| 53 | 78859 | 78872 | 78884 | 78897 | 78909 | 78922 | 78934 | 78947 | 78959 | 78972 | 78984 | 78997 | 3 \| 7 |
| 54 | 79009 | 79021 | 79034 | 79046 | 79059 | 79071 | 79084 | 79096 | 79108 | 79121 | 79133 | 79146 | 4 \| 10 |
| 55 | 9.79158 | 79170 | 79183 | 79195 | 79208 | 79220 | 79232 | 79245 | 79257 | 79269 | 79282 | 79294 | s |
| 56 | 79306 | 79319 | 79331 | 79343 | 79356 | 79368 | 79380 | 79393 | 79405 | 79417 | 79430 | 79442 | 1 \| 2 |
| 57 | 79454 | 79466 | 79479 | 79491 | 79503 | 79515 | 79528 | 79540 | 79552 | 79564 | 79577 | 79589 | 2 \| 5 |
| 58 | 79601 | 79613 | 79626 | 79638 | 79650 | 79662 | 79674 | 79687 | 79699 | 79711 | 79723 | 79735 | 3 \| 7 |
| 59 | 79748 | 79760 | 79772 | 79784 | 79796 | 79808 | 79821 | 79833 | 79845 | 79857 | 79869 | 79881 | 4 \| 10 |

# TABLE XXXI.

## Logarithms for finding the Apparent Time or Horary Angle.

### 7 Hours.

| M | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.79893 | 79905 | 79918 | 79930 | 79942 | 79954 | 79966 | 79978 | 79990 | 80002 | 80014 | 80026 | s |
| 1 | 80038 | 80050 | 80063 | 80075 | 80087 | 80099 | 80111 | 80123 | 80135 | 80147 | 80159 | 80171 | 1 \| 2 |
| 2 | 80183 | 80195 | 80207 | 80219 | 80231 | 80243 | 80255 | 80267 | 80279 | 80291 | 80303 | 80315 | 2 \| 5 |
| 3 | 80327 | 80338 | 80350 | 80362 | 80374 | 80386 | 80398 | 80410 | 80422 | 80434 | 80446 | 80458 | 3 \| 7 |
| 4 | 80470 | 80482 | 80494 | 80505 | 80517 | 80529 | 80541 | 80553 | 80565 | 80577 | 80588 | 80600 | 4 \| 9 |
| 5 | 9.80612 | 80624 | 80636 | 80648 | 80660 | 80671 | 80683 | 80695 | 80707 | 80719 | 80730 | 80742 | s |
| 6 | 80754 | 80766 | 80778 | 80789 | 80801 | 80813 | 80825 | 80836 | 80848 | 80860 | 80872 | 80883 | 1 \| 2 |
| 7 | 80895 | 80907 | 80919 | 80930 | 80942 | 80954 | 80966 | 80977 | 80989 | 81001 | 81012 | 81024 | 2 \| 5 |
| 8 | 81036 | 81047 | 81059 | 81071 | 81082 | 81094 | 81106 | 81117 | 81129 | 81141 | 81152 | 81164 | 3 \| 7 |
| 9 | 81176 | 81187 | 81199 | 81211 | 81222 | 81234 | 81245 | 81257 | 81269 | 81280 | 81292 | 81303 | 4 \| 9 |
| 10 | 9.81315 | 81326 | 81338 | 81350 | 81361 | 81373 | 81384 | 81396 | 81407 | 81419 | 81430 | 81442 | s |
| 11 | 81454 | 81465 | 81477 | 81488 | 81500 | 81511 | 81523 | 81534 | 81546 | 81557 | 81569 | 81580 | 1 \| 2 |
| 12 | 81592 | 81603 | 81614 | 81626 | 81637 | 81649 | 81660 | 81672 | 81683 | 81695 | 81706 | 81717 | 2 \| 5 |
| 13 | 81729 | 81740 | 81752 | 81763 | 81775 | 81786 | 81797 | 81809 | 81820 | 81831 | 81843 | 81854 | 3 \| 7 |
| 14 | 81866 | 81877 | 81888 | 81900 | 81911 | 81922 | 81934 | 81945 | 81956 | 81968 | 81979 | 81990 | 4 \| 9 |
| 15 | 9.82002 | 82013 | 82024 | 82036 | 82047 | 82058 | 82070 | 82081 | 82092 | 82103 | 82115 | 82126 | s |
| 16 | 82137 | 82148 | 82160 | 82171 | 82182 | 82193 | 82205 | 82216 | 82227 | 82238 | 82250 | 82261 | 1 \| 2 |
| 17 | 82272 | 82283 | 82294 | 82306 | 82317 | 82328 | 82339 | 82350 | 82362 | 82373 | 82384 | 82395 | 2 \| 4 |
| 18 | 82406 | 82417 | 82429 | 82440 | 82451 | 82462 | 82473 | 82484 | 82495 | 82507 | 82518 | 82529 | 3 \| 7 |
| 19 | 82540 | 82551 | 82562 | 82573 | 82584 | 82595 | 82606 | 82618 | 82629 | 82640 | 82651 | 82662 | 4 \| 9 |
| 20 | 9.82673 | 82684 | 82695 | 82706 | 82717 | 82728 | 82739 | 82750 | 82761 | 82772 | 82783 | 82794 | s |
| 21 | 82805 | 82816 | 82827 | 82838 | 82849 | 82860 | 82871 | 82882 | 82893 | 82904 | 82915 | 82926 | 1 \| 2 |
| 22 | 82937 | 82948 | 82959 | 82970 | 82981 | 82992 | 83003 | 83014 | 83025 | 83035 | 83046 | 83057 | 2 \| 4 |
| 23 | 83068 | 83079 | 83090 | 83101 | 83112 | 83123 | 83134 | 83144 | 83155 | 83166 | 83177 | 83188 | 3 \| 7 |
| 24 | 83199 | 83210 | 83220 | 83231 | 83242 | 83253 | 83264 | 83275 | 83285 | 83296 | 83307 | 83318 | 4 \| 9 |
| 25 | 9.83329 | 83339 | 83350 | 83361 | 83372 | 83383 | 83393 | 83404 | 83415 | 83426 | 83436 | 83447 | s |
| 26 | 83458 | 83469 | 83479 | 83490 | 83501 | 83512 | 83522 | 83533 | 83544 | 83555 | 83565 | 83576 | 1 \| 2 |
| 27 | 83587 | 83597 | 83608 | 83619 | 83629 | 83640 | 83651 | 83662 | 83672 | 83683 | 83694 | 83704 | 2 \| 4 |
| 28 | 83715 | 83725 | 83736 | 83747 | 83757 | 83768 | 83779 | 83789 | 83800 | 83811 | 83821 | 83832 | 3 \| 7 |
| 29 | 83842 | 83853 | 83864 | 83874 | 83885 | 83895 | 83906 | 83916 | 83927 | 83938 | 83948 | 83959 | 4 \| 9 |
| 30 | 9.83969 | 83980 | 83990 | 84001 | 84011 | 84022 | 84033 | 84043 | 84054 | 84064 | 84075 | 84085 | s |
| 31 | 84096 | 84106 | 84117 | 84127 | 84138 | 84148 | 84159 | 84169 | 84179 | 84190 | 84200 | 84211 | 1 \| 2 |
| 32 | 84221 | 84232 | 84242 | 84253 | 84263 | 84274 | 84284 | 84294 | 84305 | 84315 | 84326 | 84336 | 2 \| 4 |
| 33 | 84346 | 84357 | 84367 | 84378 | 84388 | 84398 | 84409 | 84419 | 84430 | 84440 | 84450 | 84461 | 3 \| 6 |
| 34 | 84471 | 84481 | 84492 | 84502 | 84512 | 84523 | 84533 | 84543 | 84554 | 84564 | 84574 | 84585 | 4 \| 8 |
| 35 | 9.84595 | 84605 | 84616 | 84626 | 84636 | 84646 | 84657 | 84667 | 84677 | 84687 | 84698 | 84708 | s |
| 36 | 84718 | 84729 | 84739 | 84749 | 84759 | 84769 | 84780 | 84790 | 84800 | 84810 | 84821 | 84831 | 1 \| 2 |
| 37 | 84841 | 84851 | 84861 | 84872 | 84882 | 84892 | 84902 | 84912 | 84923 | 84933 | 84943 | 84953 | 2 \| 4 |
| 38 | 84963 | 84973 | 84984 | 84994 | 85004 | 85014 | 85024 | 85034 | 85044 | 85054 | 85065 | 85075 | 3 \| 6 |
| 39 | 85085 | 85095 | 85105 | 85115 | 85125 | 85135 | 85145 | 85155 | 85166 | 85176 | 85186 | 85196 | 4 \| 8 |
| 40 | 9.85206 | 85216 | 85226 | 85236 | 85246 | 85256 | 85266 | 85276 | 85286 | 85296 | 85306 | 85316 | s |
| 41 | 85326 | 85336 | 85346 | 85356 | 85366 | 85376 | 85386 | 85396 | 85406 | 85416 | 85426 | 85436 | 1 \| 2 |
| 42 | 85446 | 85456 | 85466 | 85476 | 85486 | 85496 | 85506 | 85516 | 85526 | 85536 | 85546 | 85555 | 2 \| 4 |
| 43 | 85565 | 85575 | 85585 | 85595 | 85605 | 85615 | 85625 | 85635 | 85645 | 85654 | 85664 | 85674 | 3 \| 6 |
| 44 | 85684 | 85694 | 85704 | 85714 | 85724 | 85733 | 85743 | 85753 | 85763 | 85773 | 85783 | 85792 | 4 \| 8 |
| 45 | 9.85802 | 85812 | 85822 | 85832 | 85841 | 85851 | 85861 | 85871 | 85881 | 85890 | 85900 | 85910 | s |
| 46 | 85920 | 85930 | 85939 | 85949 | 85959 | 85969 | 85978 | 85988 | 85998 | 86008 | 86017 | 86027 | 1 \| 2 |
| 47 | 86037 | 86046 | 86056 | 86066 | 86076 | 86085 | 86095 | 86105 | 86114 | 86124 | 86134 | 86143 | 2 \| 4 |
| 48 | 86153 | 86163 | 86172 | 86182 | 86192 | 86201 | 86211 | 86221 | 86230 | 86240 | 86250 | 86259 | 3 \| 6 |
| 49 | 86269 | 86279 | 86288 | 86298 | 86307 | 86317 | 86327 | 86336 | 86346 | 86356 | 86365 | 86375 | 4 \| 8 |
| 50 | 9.86384 | 86394 | 86403 | 86413 | 86423 | 86432 | 86442 | 86451 | 86461 | 86470 | 86480 | 86489 | s |
| 51 | 86499 | 86509 | 86518 | 86528 | 86537 | 86547 | 86556 | 86566 | 86575 | 86585 | 86594 | 86604 | 1 \| 2 |
| 52 | 86613 | 86623 | 86632 | 86642 | 86651 | 86661 | 86670 | 86679 | 86689 | 86698 | 86708 | 86717 | 2 \| 4 |
| 53 | 86727 | 86736 | 86746 | 86755 | 86764 | 86774 | 86783 | 86793 | 86802 | 86812 | 86821 | 86830 | 3 \| 6 |
| 54 | 86840 | 86849 | 86858 | 86868 | 86877 | 86887 | 86896 | 86905 | 86915 | 86924 | 86933 | 86943 | 4 \| 8 |
| 55 | 9.86952 | 86962 | 86971 | 86980 | 86990 | 86999 | 87008 | 87018 | 87027 | 87036 | 87045 | 87055 | s |
| 56 | 87064 | 87073 | 87083 | 87092 | 87101 | 87111 | 87120 | 87129 | 87138 | 87148 | 87157 | 87166 | 1 \| 2 |
| 57 | 87175 | 87185 | 87194 | 87203 | 87212 | 87222 | 87231 | 87240 | 87249 | 87259 | 87268 | 87277 | 2 \| 4 |
| 58 | 87286 | 87295 | 87305 | 87314 | 87323 | 87332 | 87341 | 87351 | 87360 | 87369 | 87378 | 87387 | 3 \| 6 |
| 59 | 87396 | 87406 | 87415 | 87424 | 87433 | 87442 | 87451 | 87460 | 87470 | 87479 | 87488 | 87497 | 4 \| 8 |

## Logarithms for finding the Apparent Time, or Horary Angle.

### 8 Hours.

| M. | 0ˢ | 5ˢ | 10ˢ | 15ˢ | 20ˢ | 25ˢ | 30ˢ | 35ˢ | 40ˢ | 45ˢ | 50ˢ | 55ˢ | Pro. pts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9. 87506 | 87515 | 87524 | 87534 | 87543 | 87552 | 87561 | 87570 | 87579 | 87588 | 87597 | 87606 | s |
| 1 | 87615 | 87624 | 87633 | 87643 | 87652 | 87661 | 87670 | 87679 | 87688 | 87697 | 87706 | 87715 | 1 \| 2 |
| 2 | 87724 | 87733 | 87742 | 87751 | 87760 | 87769 | 87778 | 87787 | 87796 | 87805 | 87814 | 87823 | 2 \| 4 |
| 3 | 87832 | 87841 | 87850 | 87859 | 87868 | 87877 | 87886 | 87895 | 87904 | 87913 | 87921 | 87930 | 3 \| 5 |
| 4 | 87939 | 87948 | 87957 | 87966 | 87975 | 87984 | 87993 | 88002 | 88011 | 88020 | 88029 | 88038 | 4 \| 7 |
| 5 | 9. 88046 | 88055 | 88064 | 88073 | 88082 | 88091 | 88100 | 88109 | 88117 | 88126 | 88135 | 88144 | s |
| 6 | 88153 | 88162 | 88170 | 88179 | 88188 | 88197 | 88206 | 88215 | 88223 | 88232 | 88241 | 88250 | 1 \| 2 |
| 7 | 88269 | 88278 | 88276 | 88285 | 88294 | 88303 | 88311 | 88320 | 88329 | 88338 | 88346 | 88355 | 2 \| 4 |
| 8 | 88364 | 88373 | 88381 | 88390 | 88399 | 88408 | 88416 | 88425 | 88434 | 88443 | 88451 | 88460 | 3 \| 5 |
| 9 | 88469 | 88478 | 88486 | 88495 | 88503 | 88512 | 88521 | 88530 | 88538 | 88547 | 88556 | 88565 | 4 \| 7 |
| 10 | 9. 88573 | 88582 | 88590 | 88599 | 88607 | 88616 | 88625 | 88634 | 88642 | 88651 | 88659 | 88668 | s |
| 11 | 88677 | 88686 | 88694 | 88703 | 88711 | 88720 | 88728 | 88737 | 88745 | 88754 | 88763 | 88772 | 1 \| 2 |
| 12 | 88780 | 88789 | 88797 | 88806 | 88814 | 88823 | 88831 | 88840 | 88848 | 88857 | 88865 | 88874 | 2 \| 4 |
| 13 | 88882 | 88891 | 88899 | 88908 | 88916 | 88925 | 88933 | 88942 | 88950 | 88959 | 88967 | 88976 | 3 \| 5 |
| 14 | 88984 | 88993 | 89001 | 89010 | 89018 | 89027 | 89035 | 89044 | 89052 | 89061 | 89069 | 89078 | 4 \| 7 |
| 15 | 9. 89086 | 89095 | 89103 | 89112 | 89120 | 89129 | 89137 | 89145 | 89153 | 89162 | 89170 | 89179 | s |
| 16 | 89187 | 89196 | 89204 | 89213 | 89221 | 89229 | 89237 | 89246 | 89254 | 89263 | 89271 | 89279 | 1 \| 2 |
| 17 | 89287 | 89296 | 89304 | 89313 | 89321 | 89330 | 89338 | 89346 | 89354 | 89363 | 89371 | 89379 | 2 \| 4 |
| 18 | 89387 | 89396 | 89404 | 89413 | 89421 | 89429 | 89437 | 89446 | 89454 | 89462 | 89470 | 89479 | 3 \| 5 |
| 19 | 89487 | 89495 | 89503 | 89512 | 89520 | 89528 | 89536 | 89545 | 89553 | 89561 | 89569 | 89578 | 4 \| 7 |
| 20 | 9. 89586 | 89594 | 89602 | 89611 | 89619 | 89627 | 89635 | 89643 | 89651 | 89660 | 89668 | 89676 | s |
| 21 | 89684 | 89693 | 89701 | 89709 | 89717 | 89725 | 89733 | 89741 | 89749 | 89758 | 89766 | 89774 | 1 \| 2 |
| 22 | 89782 | 89790 | 89798 | 89807 | 89815 | 89823 | 89831 | 89839 | 89847 | 89853 | 89863 | 89871 | 2 \| 3 |
| 23 | 89879 | 89888 | 89896 | 89904 | 89912 | 89920 | 89928 | 89936 | 89944 | 89952 | 89960 | 89968 | 3 \| 5 |
| 24 | 89976 | 89984 | 89992 | 90000 | 90008 | 90016 | 90024 | 90032 | 90040 | 90048 | 90056 | 90064 | 4 \| 6 |
| 25 | 9. 90072 | 90080 | 90088 | 90096 | 90104 | 90112 | 90120 | 90128 | 90136 | 90144 | 90152 | 90160 | s |
| 26 | 90168 | 90176 | 90184 | 90192 | 90200 | 90208 | 90216 | 90224 | 90232 | 90240 | 90248 | 90256 | 1 \| 2 |
| 27 | 90263 | 90271 | 90279 | 90287 | 90295 | 90303 | 90311 | 90319 | 90327 | 90335 | 90342 | 90350 | 2 \| 3 |
| 28 | 90358 | 90366 | 90374 | 90382 | 90390 | 90398 | 90405 | 90413 | 90421 | 90429 | 90437 | 90445 | 3 \| 5 |
| 29 | 90452 | 90460 | 90468 | 90476 | 90484 | 90492 | 90499 | 90507 | 90515 | 90523 | 90531 | 90539 | 4 \| 6 |
| 30 | 9. 90546 | 90554 | 90562 | 90570 | 90577 | 90585 | 90593 | 90601 | 90608 | 90616 | 90624 | 90632 | s |
| 31 | 90639 | 90647 | 90655 | 90663 | 90670 | 90678 | 90686 | 90694 | 90701 | 90709 | 90717 | 90725 | 1 \| 2 |
| 32 | 90732 | 90740 | 90747 | 90755 | 90763 | 90771 | 90778 | 90786 | 90794 | 90802 | 90809 | 90817 | 2 \| 3 |
| 33 | 90824 | 90832 | 90840 | 90848 | 90855 | 90863 | 90870 | 90878 | 90885 | 90893 | 90901 | 90909 | 3 \| 5 |
| 34 | 90916 | 90924 | 90931 | 90939 | 90946 | 90954 | 90962 | 90970 | 90977 | 90985 | 90992 | 91000 | 4 \| 6 |
| 35 | 9. 91007 | 91015 | 91022 | 91030 | 91037 | 91045 | 91052 | 91060 | 91067 | 91075 | 91083 | 91091 | s |
| 36 | 91098 | 91106 | 91113 | 91121 | 91128 | 91136 | 91143 | 91151 | 91158 | 91166 | 91173 | 91181 | 1 \| 2 |
| 37 | 91188 | 91196 | 91203 | 91211 | 91218 | 91226 | 91233 | 91241 | 91248 | 91255 | 91262 | 91270 | 2 \| 3 |
| 38 | 91277 | 91285 | 91292 | 91300 | 91307 | 91315 | 91322 | 91330 | 91337 | 91345 | 91352 | 91360 | 3 \| 5 |
| 39 | 91367 | 91374 | 91381 | 91389 | 91396 | 91404 | 91411 | 91419 | 91426 | 91433 | 91440 | 91448 | 4 \| 6 |
| 40 | 9. 91455 | 91463 | 91470 | 91478 | 91485 | 91492 | 91499 | 91507 | 91514 | 91522 | 91529 | 91536 | s |
| 41 | 91543 | 91551 | 91558 | 91566 | 91573 | 91580 | 91587 | 91595 | 91602 | 91609 | 91616 | 91624 | 1 \| 2 |
| 42 | 91631 | 91638 | 91645 | 91653 | 91660 | 91667 | 91674 | 91682 | 91689 | 91696 | 91703 | 91711 | 2 \| 3 |
| 43 | 91718 | 91725 | 91732 | 91740 | 91747 | 91754 | 91761 | 91769 | 91776 | 91783 | 91790 | 91798 | 3 \| 5 |
| 44 | 91805 | 91812 | 91819 | 91826 | 91833 | 91841 | 91848 | 91855 | 91862 | 91869 | 91876 | 91884 | 4 \| 6 |
| 45 | 9. 91891 | 91898 | 91905 | 91912 | 91919 | 91927 | 91934 | 91941 | 91948 | 91955 | 91962 | 91969 | s |
| 46 | 91976 | 91984 | 91991 | 91998 | 92005 | 92012 | 92019 | 92026 | 92033 | 92040 | 92047 | 92054 | 1 \| 1 |
| 47 | 92061 | 92069 | 92076 | 92083 | 92090 | 92097 | 92104 | 92111 | 92118 | 92125 | 92132 | 92139 | 2 \| 3 |
| 48 | 92146 | 92153 | 92160 | 92167 | 92174 | 92181 | 92188 | 92195 | 92202 | 92209 | 92216 | 92223 | 3 \| 4 |
| 49 | 92230 | 92237 | 92244 | 92251 | 92258 | 92265 | 92272 | 92279 | 92286 | 92293 | 92300 | 92307 | 4 \| 6 |
| 50 | 9. 92314 | 92321 | 92328 | 92335 | 92342 | 92349 | 92355 | 92362 | 92369 | 92376 | 92383 | 92390 | s |
| 51 | 92397 | 92404 | 92411 | 92418 | 92425 | 92432 | 92438 | 92445 | 92452 | 92459 | 92466 | 92473 | 1 \| 1 |
| 52 | 92480 | 92487 | 92493 | 92500 | 92507 | 92514 | 92521 | 92528 | 92534 | 92541 | 92548 | 92555 | 2 \| 3 |
| 53 | 92562 | 92569 | 92575 | 92582 | 92589 | 92596 | 92603 | 92610 | 92616 | 92623 | 92630 | 92637 | 3 \| 4 |
| 54 | 92643 | 92650 | 92657 | 92664 | 92670 | 92677 | 92684 | 92691 | 92698 | 92705 | 92711 | 92718 | 4 \| 6 |
| 55 | 9. 92725 | 92732 | 92738 | 92745 | 92751 | 92758 | 92765 | 92772 | 92778 | 92785 | 92792 | 92799 | s |
| 56 | 92805 | 92812 | 92819 | 92826 | 92832 | 92839 | 92845 | 92852 | 92859 | 92866 | 92872 | 92879 | 1 \| 1 |
| 57 | 92885 | 92892 | 92899 | 92906 | 92912 | 92919 | 92925 | 92932 | 92939 | 92946 | 92952 | 92959 | 2 \| 3 |
| 58 | 92965 | 92972 | 92978 | 92985 | 92992 | 92999 | 93005 | 93012 | 93018 | 93025 | 93031 | 93038 | 3 \| 4 |
| 59 | 93044 | 93051 | 93057 | 93064 | 93071 | 93078 | 93084 | 93091 | 93097 | 93104 | 93110 | 93117 | 4 \| 6 |

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# TABLE XXXIII.

LOGARITHMS for finding the correction to reduce the SUN's Declination, Right Ascension, &c. to any time under the Meridian of Greenwich.

| Min. or Sec. | HOURS, DEGREES, OR MINUTES. | | | | | | | | | | | | Min. or Sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 0 | | 1.3802 | 1.0792 | 9031 | 7781 | 6812 | 6021 | 5351 | 4771 | 4260 | 3802 | 3388 | 0 |
| 1 | 3.1584 | 1.3730 | 1.0756 | 9007 | 7763 | 6798 | 6009 | 5341 | 4762 | 4252 | 3795 | 3382 | 1 |
| 2 | 2.8573 | 1.3660 | 1.0720 | 8983 | 7745 | 6784 | 5997 | 5330 | 4753 | 4244 | 3788 | 3375 | 2 |
| 3 | 2.6812 | 1.3590 | 1.0685 | 8959 | 7728 | 6769 | 5985 | 5320 | 4744 | 4236 | 3780 | 3368 | 3 |
| 4 | 2.5563 | 1.3522 | 1.0649 | 8935 | 7710 | 6755 | 5973 | 5309 | 4735 | 4228 | 3773 | 3362 | 4 |
| 5 | 2.4594 | 1.3454 | 1.0614 | 8912 | 7692 | 6741 | 5961 | 5300 | 4726 | 4220 | 3766 | 3355 | 5 |
| 6 | 2.3802 | 1.3388 | 1.0580 | 8888 | 7674 | 6726 | 5949 | 5289 | 4717 | 4212 | 3759 | 3349 | 6 |
| 7 | 2.3133 | 1.3323 | 1.0546 | 8865 | 7657 | 6712 | 5937 | 5279 | 4708 | 4204 | 3752 | 3342 | 7 |
| 8 | 2.2553 | 1.3259 | 1.0512 | 8842 | 7639 | 6698 | 5925 | 5269 | 4699 | 4196 | 3745 | 3336 | 8 |
| 9 | 2.2041 | 1.3195 | 1.0478 | 8819 | 7622 | 6684 | 5913 | 5259 | 4690 | 4188 | 3737 | 3329 | 9 |
| 10 | 2.1584 | 1.3133 | 1.0444 | 8796 | 7604 | 6670 | 5902 | 5249 | 4682 | 4180 | 3730 | 3323 | 10 |
| 11 | 2.1170 | 1.3071 | 1.0411 | 8773 | 7587 | 6656 | 5890 | 5239 | 4673 | 4172 | 3723 | 3316 | 11 |
| 12 | 2.0792 | 1.3010 | 1.0378 | 8751 | 7570 | 6642 | 5878 | 5229 | 4664 | 4164 | 3716 | 3310 | 12 |
| 13 | 2.0444 | 1.2950 | 1.0345 | 8728 | 7552 | 6628 | 5866 | 5219 | 4655 | 4156 | 3709 | 3303 | 13 |
| 14 | 2.0122 | 1.2891 | 1.0313 | 8706 | 7535 | 6614 | 5855 | 5209 | 4646 | 4148 | 3702 | 3297 | 14 |
| 15 | 1.9823 | 1.2833 | 1.0280 | 8683 | 7518 | 6600 | 5843 | 5199 | 4638 | 4141 | 3695 | 3291 | 15 |
| 16 | 1.9542 | 1.2775 | 1.0248 | 8661 | 7501 | 6587 | 5832 | 5189 | 4629 | 4133 | 3688 | 3284 | 16 |
| 17 | 1.9279 | 1.2719 | 1.0216 | 8639 | 7484 | 6573 | 5820 | 5179 | 4620 | 4125 | 3681 | 3278 | 17 |
| 18 | 1.9031 | 1.2663 | 1.0185 | 8617 | 7467 | 6559 | 5809 | 5169 | 4611 | 4117 | 3674 | 3271 | 18 |
| 19 | 1.8796 | 1.2607 | 1.0153 | 8595 | 7451 | 6546 | 5797 | 5159 | 4603 | 4109 | 3667 | 3265 | 19 |
| 20 | 1.8573 | 1.2553 | 1.0122 | 8573 | 7434 | 6532 | 5786 | 5149 | 4594 | 4102 | 3660 | 3258 | 20 |
| 21 | 1.8361 | 1.2499 | 1.0091 | 8552 | 7417 | 6518 | 5774 | 5139 | 4585 | 4094 | 3653 | 3252 | 21 |
| 22 | 1.8159 | 1.2445 | 1.0061 | 8530 | 7401 | 6505 | 5763 | 5129 | 4577 | 4086 | 3646 | 3246 | 22 |
| 23 | 1.7966 | 1.2393 | 1.0030 | 8509 | 7384 | 6492 | 5752 | 5120 | 4568 | 4079 | 3639 | 3239 | 23 |
| 24 | 1.7782 | 1.2341 | 1.0000 | 8487 | 7368 | 6478 | 5740 | 5110 | 4559 | 4071 | 3632 | 3233 | 24 |
| 25 | 1.7604 | 1.2289 | 0.9970 | 8466 | 7351 | 6465 | 5729 | 5100 | 4551 | 4063 | 3625 | 3227 | 25 |
| 26 | 1.7434 | 1.2239 | 0.9940 | 8445 | 7335 | 6451 | 5718 | 5090 | 4542 | 4055 | 3618 | 3220 | 26 |
| 27 | 1.7270 | 1.2188 | 0.9910 | 8424 | 7318 | 6438 | 5706 | 5081 | 4534 | 4048 | 3611 | 3214 | 27 |
| 28 | 1.7112 | 1.2139 | 0.9881 | 8403 | 7302 | 6425 | 5695 | 5071 | 4525 | 4040 | 3604 | 3208 | 28 |
| 29 | 1.6960 | 1.2090 | 0.9852 | 8382 | 7286 | 6412 | 5684 | 5061 | 4516 | 4032 | 3597 | 3201 | 29 |
| 30 | 1.6812 | 1.2041 | 0.9823 | 8361 | 7270 | 6398 | 5673 | 5051 | 4508 | 4025 | 3590 | 3195 | 30 |
| 31 | 1.6670 | 1.1993 | 0.9794 | 8341 | 7254 | 6385 | 5662 | 5042 | 4499 | 4017 | 3583 | 3189 | 31 |
| 32 | 1.6532 | 1.1946 | 0.9765 | 8320 | 7238 | 6372 | 5651 | 5032 | 4491 | 4010 | 3576 | 3183 | 32 |
| 33 | 1.6398 | 1.1899 | 0.9737 | 8300 | 7222 | 6359 | 5640 | 5023 | 4482 | 4002 | 3570 | 3176 | 33 |
| 34 | 1.6269 | 1.1852 | 0.9708 | 8279 | 7206 | 6346 | 5629 | 5013 | 4474 | 3994 | 3563 | 3170 | 34 |
| 35 | 1.6143 | 1.1806 | 0.9680 | 8259 | 7190 | 6333 | 5618 | 5003 | 4466 | 3987 | 3556 | 3164 | 35 |
| 36 | 1.6021 | 1.1761 | 0.9652 | 8239 | 7174 | 6320 | 5607 | 4994 | 4457 | 3979 | 3549 | 3157 | 36 |
| 37 | 1.5902 | 1.1716 | 0.9625 | 8219 | 7159 | 6307 | 5596 | 4984 | 4449 | 3972 | 3542 | 3151 | 37 |
| 38 | 1.5786 | 1.1671 | 0.9597 | 8199 | 7143 | 6294 | 5585 | 4975 | 4440 | 3964 | 3535 | 3145 | 38 |
| 39 | 1.5673 | 1.1627 | 0.9570 | 8179 | 7128 | 6282 | 5574 | 4965 | 4432 | 3957 | 3529 | 3139 | 39 |
| 40 | 1.5563 | 1.1584 | 0.9542 | 8159 | 7112 | 6269 | 5563 | 4956 | 4424 | 3949 | 3522 | 3133 | 40 |
| 41 | 1.5456 | 1.1540 | 0.9515 | 8140 | 7097 | 6256 | 5552 | 4947 | 4415 | 3942 | 3515 | 3126 | 41 |
| 42 | 1.5351 | 1.1498 | 0.9488 | 8120 | 7081 | 6243 | 5541 | 4937 | 4407 | 3934 | 3508 | 3120 | 42 |
| 43 | 1.5249 | 1.1455 | 0.9462 | 8101 | 7066 | 6231 | 5531 | 4928 | 4399 | 3927 | 3501 | 3114 | 43 |
| 44 | 1.5149 | 1.1413 | 0.9435 | 8081 | 7050 | 6218 | 5520 | 4918 | 4390 | 3919 | 3495 | 3108 | 44 |
| 45 | 1.5051 | 1.1372 | 0.9408 | 8062 | 7035 | 6205 | 5509 | 4909 | 4382 | 3912 | 3488 | 3102 | 45 |
| 46 | 1.4956 | 1.1331 | 0.9382 | 8043 | 7020 | 6193 | 5498 | 4900 | 4374 | 3905 | 3481 | 3096 | 46 |
| 47 | 1.4863 | 1.1290 | 0.9356 | 8023 | 7005 | 6180 | 5488 | 4890 | 4365 | 3897 | 3475 | 3089 | 47 |
| 48 | 1.4771 | 1.1249 | 0.9330 | 8004 | 6990 | 6168 | 5477 | 4881 | 4357 | 3890 | 3468 | 3083 | 48 |
| 49 | 1.4682 | 1.1209 | 0.9305 | 7985 | 6975 | 6155 | 5466 | 4872 | 4349 | 3882 | 3461 | 3077 | 49 |
| 50 | 1.4594 | 1.1170 | 0.9279 | 7966 | 6960 | 6143 | 5456 | 4863 | 4341 | 3875 | 3454 | 3071 | 50 |
| 51 | 1.4508 | 1.1130 | 0.9254 | 7947 | 6945 | 6131 | 5445 | 4853 | 4333 | 3868 | 3448 | 3065 | 51 |
| 52 | 1.4424 | 1.1091 | 0.9228 | 7929 | 6930 | 6118 | 5435 | 4844 | 4324 | 3860 | 3441 | 3059 | 52 |
| 53 | 1.4341 | 1.1053 | 0.9203 | 7910 | 6915 | 6106 | 5424 | 4835 | 4316 | 3853 | 3434 | 3053 | 53 |
| 54 | 1.4260 | 1.1015 | 0.9178 | 7891 | 6900 | 6094 | 5414 | 4826 | 4308 | 3846 | 3428 | 3047 | 54 |
| 55 | 1.4180 | 1.0977 | 0.9153 | 7873 | 6885 | 6081 | 5403 | 4817 | 4300 | 3838 | 3421 | 3041 | 55 |
| 56 | 1.4102 | 1.0940 | 0.9128 | 7854 | 6871 | 6069 | 5393 | 4808 | 4292 | 3831 | 3415 | 3034 | 56 |
| 57 | 1.4025 | 1.0902 | 0.9104 | 7836 | 6856 | 6057 | 5382 | 4798 | 4284 | 3824 | 3408 | 3028 | 57 |
| 58 | 1.3949 | 1.0865 | 0.9079 | 7818 | 6841 | 6045 | 5372 | 4789 | 4276 | 3817 | 3401 | 3022 | 58 |
| 59 | 1.3875 | 1.0828 | 0.9055 | 7800 | 6827 | 6033 | 5361 | 4780 | 4268 | 3809 | 3395 | 3016 | 59 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |

# TABLE XXXIII.

**LOGARITHMS for finding the correction to reduce the SUN'S Declination, Right Ascension, &c. to any time under the Meridian of Greenwich.**

| Min. or Sec. | HOURS, DEGREES, OR MINUTES. | | | | | | | | | | | | Min. or Sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | |
| 0 | 3010 | 2663 | 2341 | 2041 | 1761 | 1498 | 1249 | 1015 | 0792 | 0580 | 0378 | 0185 | 0 |
| 1 | 3004 | 2657 | 2336 | 2036 | 1756 | 1493 | 1245 | 1011 | 0788 | 0576 | 0375 | 0182 | 1 |
| 2 | 2996 | 2652 | 2330 | 2031 | 1752 | 1489 | 1241 | 1007 | 0785 | 0573 | 0371 | 0179 | 2 |
| 3 | 2992 | 2646 | 2325 | 2027 | 1747 | 1485 | 1237 | 1003 | 0781 | 0570 | 0368 | 0175 | 3 |
| 4 | 2986 | 2640 | 2320 | 2022 | 1743 | 1481 | 1233 | 0999 | 0777 | 0566 | 0365 | 0172 | 4 |
| 5 | 2980 | 2635 | 2315 | 2017 | 1738 | 1476 | 1229 | 0996 | 0774 | 0563 | 0361 | 0169 | 5 |
| 6 | 2974 | 2629 | 2310 | 2012 | 1734 | 1472 | 1225 | 0992 | 0770 | 0559 | 0358 | 0166 | 6 |
| 7 | 2968 | 2624 | 2305 | 2008 | 1729 | 1468 | 1221 | 0988 | 0767 | 0556 | 0355 | 0163 | 7 |
| 8 | 2962 | 2618 | 2300 | 2003 | 1725 | 1464 | 1217 | 0984 | 0763 | 0552 | 0352 | 0160 | 8 |
| 9 | 2956 | 2613 | 2295 | 1998 | 1720 | 1459 | 1213 | 0980 | 0759 | 0549 | 0348 | 0157 | 9 |
| 10 | 2950 | 2607 | 2289 | 1993 | 1716 | 1455 | 1209 | 0977 | 0756 | 0546 | 0345 | 0153 | 10 |
| 11 | 2944 | 2602 | 2284 | 1988 | 1711 | 1451 | 1205 | 0973 | 0753 | 0542 | 0342 | 0150 | 11 |
| 12 | 2938 | 2596 | 2279 | 1984 | 1707 | 1447 | 1201 | 0969 | 0749 | 0539 | 0339 | 0147 | 12 |
| 13 | 2933 | 2591 | 2274 | 1979 | 1702 | 1443 | 1197 | 0965 | 0745 | 0535 | 0335 | 0144 | 13 |
| 14 | 2927 | 2585 | 2269 | 1974 | 1698 | 1438 | 1193 | 0962 | 0741 | 0532 | 0332 | 0141 | 14 |
| 15 | 2921 | 2580 | 2264 | 1969 | 1694 | 1434 | 1189 | 0958 | 0738 | 0528 | 0329 | 0138 | 15 |
| 16 | 2915 | 2574 | 2259 | 1965 | 1689 | 1430 | 1185 | 0954 | 0734 | 0525 | 0326 | 0135 | 16 |
| 17 | 2909 | 2569 | 2254 | 1960 | 1685 | 1426 | 1181 | 0950 | 0731 | 0522 | 0322 | 0132 | 17 |
| 18 | 2903 | 2564 | 2249 | 1955 | 1680 | 1422 | 1178 | 0947 | 0727 | 0518 | 0319 | 0128 | 18 |
| 19 | 2897 | 2558 | 2244 | 1950 | 1676 | 1417 | 1174 | 0943 | 0724 | 0515 | 0316 | 0125 | 19 |
| 20 | 2891 | 2553 | 2239 | 1946 | 1671 | 1413 | 1170 | 0939 | 0720 | 0511 | 0313 | 0122 | 20 |
| 21 | 2885 | 2547 | 2234 | 1941 | 1667 | 1409 | 1166 | 0935 | 0716 | 0508 | 0309 | 0119 | 21 |
| 22 | 2880 | 2542 | 2229 | 1936 | 1662 | 1405 | 1162 | 0932 | 0713 | 0505 | 0306 | 0116 | 22 |
| 23 | 2874 | 2536 | 2223 | 1932 | 1658 | 1401 | 1158 | 0928 | 0709 | 0501 | 0303 | 0113 | 23 |
| 24 | 2868 | 2531 | 2218 | 1927 | 1654 | 1397 | 1154 | 0924 | 0706 | 0498 | 0300 | 0110 | 24 |
| 25 | 2862 | 2526 | 2213 | 1922 | 1649 | 1392 | 1150 | 0920 | 0702 | 0495 | 0296 | 0107 | 25 |
| 26 | 2856 | 2520 | 2208 | 1917 | 1645 | 1388 | 1146 | 0917 | 0699 | 0491 | 0293 | 0104 | 26 |
| 27 | 2850 | 2515 | 2203 | 1913 | 1640 | 1384 | 1142 | 0913 | 0695 | 0488 | 0290 | 0101 | 27 |
| 28 | 2845 | 2510 | 2198 | 1908 | 1636 | 1380 | 1138 | 0909 | 0692 | 0484 | 0287 | 0098 | 28 |
| 29 | 2839 | 2504 | 2193 | 1903 | 1632 | 1376 | 1134 | 0905 | 0688 | 0481 | 0283 | 0094 | 29 |
| 30 | 2833 | 2499 | 2188 | 1899 | 1627 | 1372 | 1130 | 0902 | 0685 | 0478 | 0280 | 0091 | 30 |
| 31 | 2827 | 2493 | 2183 | 1894 | 1623 | 1368 | 1126 | 0898 | 0681 | 0474 | 0277 | 0088 | 31 |
| 32 | 2821 | 2488 | 2178 | 1889 | 1618 | 1363 | 1123 | 0895 | 0677 | 0471 | 0274 | 0085 | 32 |
| 33 | 2816 | 2483 | 2173 | 1885 | 1614 | 1359 | 1119 | 0891 | 0674 | 0468 | 0271 | 0082 | 33 |
| 34 | 2810 | 2477 | 2168 | 1880 | 1610 | 1355 | 1115 | 0887 | 0670 | 0464 | 0267 | 0079 | 34 |
| 35 | 2804 | 2472 | 2163 | 1875 | 1605 | 1351 | 1111 | 0883 | 0667 | 0461 | 0264 | 0076 | 35 |
| 36 | 2798 | 2467 | 2159 | 1871 | 1601 | 1347 | 1107 | 0880 | 0663 | 0458 | 0261 | 0073 | 36 |
| 37 | 2793 | 2461 | 2154 | 1866 | 1597 | 1343 | 1103 | 0876 | 0660 | 0454 | 0258 | 0070 | 37 |
| 38 | 2787 | 2456 | 2149 | 1862 | 1592 | 1339 | 1099 | 0872 | 0656 | 0451 | 0255 | 0067 | 38 |
| 39 | 2781 | 2451 | 2144 | 1857 | 1588 | 1335 | 1095 | 0868 | 0653 | 0447 | 0251 | 0064 | 39 |
| 40 | 2775 | 2445 | 2139 | 1852 | 1584 | 1331 | 1091 | 0865 | 0649 | 0444 | 0248 | 0061 | 40 |
| 41 | 2770 | 2440 | 2134 | 1848 | 1579 | 1326 | 1088 | 0861 | 0646 | 0441 | 0245 | 0058 | 41 |
| 42 | 2764 | 2435 | 2129 | 1843 | 1575 | 1322 | 1084 | 0858 | 0642 | 0438 | 0242 | 0055 | 42 |
| 43 | 2758 | 2430 | 2124 | 1838 | 1571 | 1318 | 1080 | 0854 | 0639 | 0434 | 0239 | 0052 | 43 |
| 44 | 2753 | 2424 | 2119 | 1834 | 1566 | 1314 | 1076 | 0850 | 0635 | 0431 | 0235 | 0048 | 44 |
| 45 | 2747 | 2419 | 2114 | 1829 | 1562 | 1310 | 1072 | 0846 | 0632 | 0427 | 0232 | 0045 | 45 |
| 46 | 2741 | 2414 | 2109 | 1825 | 1558 | 1306 | 1068 | 0843 | 0628 | 0424 | 0229 | 0042 | 46 |
| 47 | 2736 | 2409 | 2104 | 1820 | 1553 | 1302 | 1064 | 0839 | 0625 | 0421 | 0226 | 0039 | 47 |
| 48 | 2730 | 2403 | 2099 | 1816 | 1549 | 1298 | 1060 | 0835 | 0621 | 0418 | 0223 | 0036 | 48 |
| 49 | 2724 | 2398 | 2095 | 1811 | 1545 | 1294 | 1057 | 0832 | 0618 | 0414 | 0220 | 0033 | 49 |
| 50 | 2719 | 2393 | 2090 | 1806 | 1540 | 1290 | 1053 | 0828 | 0614 | 0411 | 0216 | 0030 | 50 |
| 51 | 2713 | 2388 | 2085 | 1802 | 1536 | 1286 | 1049 | 0824 | 0611 | 0408 | 0213 | 0027 | 51 |
| 52 | 2707 | 2382 | 2080 | 1797 | 1532 | 1282 | 1045 | 0821 | 0608 | 0404 | 0210 | 0024 | 52 |
| 53 | 2702 | 2377 | 2075 | 1793 | 1527 | 1278 | 1041 | 0817 | 0604 | 0401 | 0207 | 0021 | 53 |
| 54 | 2696 | 2372 | 2070 | 1788 | 1523 | 1274 | 1037 | 0814 | 0601 | 0398 | 0204 | 0018 | 54 |
| 55 | 2690 | 2367 | 2065 | 1784 | 1519 | 1270 | 1034 | 0810 | 0597 | 0394 | 0201 | 0015 | 55 |
| 56 | 2685 | 2362 | 2061 | 1779 | 1515 | 1265 | 1030 | 0806 | 0594 | 0391 | 0197 | 0012 | 56 |
| 57 | 2679 | 2356 | 2056 | 1774 | 1510 | 1261 | 1026 | 0803 | 0590 | 0388 | 0194 | 0009 | 57 |
| 58 | 2674 | 2351 | 2051 | 1770 | 1506 | 1257 | 1022 | 0799 | 0587 | 0384 | 0191 | 0006 | 58 |
| 59 | 2668 | 2346 | 2046 | 1765 | 1502 | 1253 | 1018 | 0795 | 0583 | 0381 | 0188 | 0003 | 59 |
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | |

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## PROPORTIONAL LOGARITHMS.

| ′ | h. m. 0° 0′ | h. m. 0° 1′ | h. m. 0° 2′ | h. m. 0° 3′ | h. m. 0° 4′ | h. m. 0° 5′ | h. m. 0° 6′ | h. m. 0° 7′ | h. m. 0° 8′ | ′ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 2.2553 | 1.9542 | 1.7782 | 1.6532 | 1.5563 | 1.4771 | 1.4102 | 1.3522 | 0 |
| 1 | 4.0334 | 2.2481 | 1.9506 | 1.7757 | 1.6514 | 1.5549 | 1.4759 | 1.4091 | 1.3513 | 1 |
| 2 | 3.7324 | 2.2410 | 1.9471 | 1.7734 | 1.6496 | 1.5534 | 1.4747 | 1.4081 | 1.3504 | 2 |
| 3 | 3.5563 | 2.2341 | 1.9436 | 1.7710 | 1.6478 | 1.5520 | 1.4735 | 1.4071 | 1.3495 | 3 |
| 4 | 3.4314 | 2.2272 | 1.9400 | 1.7686 | 1.6460 | 1.5506 | 1.4723 | 1.4061 | 1.3486 | 4 |
| 5 | 3.3345 | 2.2205 | 1.9365 | 1.7663 | 1.6443 | 1.5491 | 1.4711 | 1.4050 | 1.3477 | 5 |
| 6 | 3.2553 | 2.2139 | 1.9331 | 1.7639 | 1.6425 | 1.5477 | 1.4699 | 1.4040 | 1.3468 | 6 |
| 7 | 3.1883 | 2.2073 | 1.9296 | 1.7616 | 1.6407 | 1.5463 | 1.4688 | 1.4030 | 1.3459 | 7 |
| 8 | 3.1303 | 2.2009 | 1.9262 | 1.7593 | 1.6390 | 1.5449 | 1.4676 | 1.4020 | 1.3450 | 8 |
| 9 | 3.0792 | 2.1946 | 1.9228 | 1.7570 | 1.6372 | 1.5435 | 1.4664 | 1.4010 | 1.3441 | 9 |
| 10 | 3.0334 | 2.1883 | 1.9195 | 1.7547 | 1.6355 | 1.5421 | 1.4652 | 1.4000 | 1.3432 | 10 |
| 11 | 2.9920 | 2.1822 | 1.9162 | 1.7524 | 1.6338 | 1.5407 | 1.4640 | 1.3989 | 1.3423 | 11 |
| 12 | 2.9542 | 2.1761 | 1.9128 | 1.7501 | 1.6320 | 1.5393 | 1.4629 | 1.3979 | 1.3415 | 12 |
| 13 | 2.9196 | 2.1701 | 1.9096 | 1.7479 | 1.6303 | 1.5379 | 1.4617 | 1.3969 | 1.3406 | 13 |
| 14 | 2.8873 | 2.1642 | 1.9063 | 1.7456 | 1.6286 | 1.5365 | 1.4606 | 1.3959 | 1.3397 | 14 |
| 15 | 2.8573 | 2.1584 | 1.9031 | 1.7434 | 1.6269 | 1.5351 | 1.4594 | 1.3949 | 1.3388 | 15 |
| 16 | 2.8293 | 2.1526 | 1.8999 | 1.7412 | 1.6252 | 1.5337 | 1.4582 | 1.3939 | 1.3379 | 16 |
| 17 | 2.8030 | 2.1469 | 1.8967 | 1.7390 | 1.6235 | 1.5324 | 1.4571 | 1.3929 | 1.3371 | 17 |
| 18 | 2.7782 | 2.1413 | 1.8935 | 1.7368 | 1.6218 | 1.5310 | 1.4559 | 1.3919 | 1.3362 | 18 |
| 19 | 2.7547 | 2.1358 | 1.8904 | 1.7346 | 1.6201 | 1.5296 | 1.4548 | 1.3910 | 1.3353 | 19 |
| 20 | 2.7324 | 2.1303 | 1.8873 | 1.7324 | 1.6185 | 1.5283 | 1.4536 | 1.3900 | 1.3345 | 20 |
| 21 | 2.7112 | 2.1249 | 1.8842 | 1.7302 | 1.6168 | 1.5269 | 1.4525 | 1.3890 | 1.3336 | 21 |
| 22 | 2.6910 | 2.1196 | 1.8811 | 1.7281 | 1.6151 | 1.5256 | 1.4514 | 1.3880 | 1.3327 | 22 |
| 23 | 2.6717 | 2.1143 | 1.8781 | 1.7259 | 1.6135 | 1.5242 | 1.4502 | 1.3870 | 1.3319 | 23 |
| 24 | 2.6532 | 2.1091 | 1.8751 | 1.7238 | 1.6118 | 1.5229 | 1.4491 | 1.3860 | 1.3310 | 24 |
| 25 | 2.6355 | 2.1040 | 1.8721 | 1.7217 | 1.6102 | 1.5215 | 1.4480 | 1.3851 | 1.3301 | 25 |
| 26 | 2.6185 | 2.0989 | 1.8691 | 1.7196 | 1.6085 | 1.5202 | 1.4468 | 1.3841 | 1.3293 | 26 |
| 27 | 2.6021 | 2.0939 | 1.8661 | 1.7175 | 1.6069 | 1.5189 | 1.4457 | 1.3831 | 1.3284 | 27 |
| 28 | 2.5863 | 2.0889 | 1.8632 | 1.7154 | 1.6053 | 1.5175 | 1.4446 | 1.3821 | 1.3276 | 28 |
| 29 | 2.5710 | 2.0840 | 1.8602 | 1.7133 | 1.6037 | 1.5162 | 1.4435 | 1.3812 | 1.3267 | 29 |
| 30 | 2.5563 | 2.0792 | 1.8573 | 1.7112 | 1.6021 | 1.5149 | 1.4424 | 1.3802 | 1.3259 | 30 |
| 31 | 2.5421 | 2.0744 | 1.8544 | 1.7091 | 1.6005 | 1.5136 | 1.4412 | 1.3792 | 1.3250 | 31 |
| 32 | 2.5283 | 2.0696 | 1.8516 | 1.7071 | 1.5989 | 1.5123 | 1.4401 | 1.3783 | 1.3242 | 32 |
| 33 | 2.5149 | 2.0649 | 1.8487 | 1.7050 | 1.5973 | 1.5110 | 1.4390 | 1.3773 | 1.3233 | 33 |
| 34 | 2.5019 | 2.0603 | 1.8459 | 1.7030 | 1.5957 | 1.5097 | 1.4379 | 1.3764 | 1.3225 | 34 |
| 35 | 2.4894 | 2.0557 | 1.8431 | 1.7010 | 1.5941 | 1.5084 | 1.4368 | 1.3754 | 1.3216 | 35 |
| 36 | 2.4771 | 2.0512 | 1.8403 | 1.6990 | 1.5925 | 1.5071 | 1.4357 | 1.3745 | 1.3208 | 36 |
| 37 | 2.4652 | 2.0467 | 1.8375 | 1.6970 | 1.5909 | 1.5058 | 1.4346 | 1.3735 | 1.3199 | 37 |
| 38 | 2.4536 | 2.0422 | 1.8348 | 1.6950 | 1.5894 | 1.5045 | 1.4335 | 1.3726 | 1.3191 | 38 |
| 39 | 2.4424 | 2.0378 | 1.8320 | 1.6930 | 1.5878 | 1.5032 | 1.4325 | 1.3716 | 1.3183 | 39 |
| 40 | 2.4314 | 2.0334 | 1.8293 | 1.6910 | 1.5863 | 1.5019 | 1.4314 | 1.3707 | 1.3174 | 40 |
| 41 | 2.4206 | 2.0291 | 1.8266 | 1.6890 | 1.5847 | 1.5007 | 1.4303 | 1.3697 | 1.3166 | 41 |
| 42 | 2.4102 | 2.0248 | 1.8239 | 1.6871 | 1.5832 | 1.4994 | 1.4292 | 1.3688 | 1.3158 | 42 |
| 43 | 2.4000 | 2.0206 | 1.8212 | 1.6851 | 1.5816 | 1.4981 | 1.4281 | 1.3678 | 1.3149 | 43 |
| 44 | 2.3900 | 2.0164 | 1.8186 | 1.6832 | 1.5801 | 1.4969 | 1.4270 | 1.3669 | 1.3141 | 44 |
| 45 | 2.3802 | 2.0122 | 1.8159 | 1.6812 | 1.5786 | 1.4956 | 1.4260 | 1.3660 | 1.3133 | 45 |
| 46 | 2.3707 | 2.0081 | 1.8133 | 1.6793 | 1.5771 | 1.4943 | 1.4249 | 1.3650 | 1.3124 | 46 |
| 47 | 2.3613 | 2.0040 | 1.8107 | 1.6774 | 1.5755 | 1.4931 | 1.4238 | 1.3641 | 1.3116 | 47 |
| 48 | 2.3522 | 2.0000 | 1.8081 | 1.6755 | 1.5740 | 1.4918 | 1.4228 | 1.3632 | 1.3108 | 48 |
| 49 | 2.3432 | 1.9960 | 1.8055 | 1.6736 | 1.5725 | 1.4906 | 1.4217 | 1.3623 | 1.3100 | 49 |
| 50 | 2.3345 | 1.9920 | 1.8030 | 1.6717 | 1.5710 | 1.4894 | 1.4206 | 1.3613 | 1.3091 | 50 |
| 51 | 2.3259 | 1.9881 | 1.8004 | 1.6698 | 1.5695 | 1.4881 | 1.4196 | 1.3604 | 1.3083 | 51 |
| 52 | 2.3174 | 1.9842 | 1.7979 | 1.6679 | 1.5680 | 1.4869 | 1.4185 | 1.3595 | 1.3075 | 52 |
| 53 | 2.3091 | 1.9803 | 1.7954 | 1.6661 | 1.5666 | 1.4856 | 1.4175 | 1.3586 | 1.3067 | 53 |
| 54 | 2.3010 | 1.9765 | 1.7929 | 1.6642 | 1.5651 | 1.4844 | 1.4164 | 1.3576 | 1.3059 | 54 |
| 55 | 2.2931 | 1.9727 | 1.7904 | 1.6624 | 1.5636 | 1.4832 | 1.4154 | 1.3567 | 1.3051 | 55 |
| 56 | 2.2852 | 1.9690 | 1.7879 | 1.6605 | 1.5621 | 1.4820 | 1.4143 | 1.3558 | 1.3043 | 56 |
| 57 | 2.2775 | 1.9652 | 1.7855 | 1.6587 | 1.5607 | 1.4808 | 1.4133 | 1.3549 | 1.3034 | 57 |
| 58 | 2.2700 | 1.9615 | 1.7830 | 1.6568 | 1.5592 | 1.4795 | 1.4122 | 1.3540 | 1.3026 | 58 |
| 59 | 2.2626 | 1.9579 | 1.7806 | 1.6550 | 1.5578 | 1.4783 | 1.4112 | 1.3531 | 1.3018 | 59 |
| 60 | 2.2553 | 1.9542 | 1.7782 | 1.6532 | 1.5563 | 1.4771 | 1.4102 | 1.3522 | 1.3010 | 60 |

# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. / | h. m. 0° 9′ | h. m. 0° 10′ | h. m. 0° 11′ | h. m. 0° 12′ | h. m. 0° 13′ | h. m. 0° 14′ | h. m. 0° 15′ | h. m. 0° 16′ | h. m. 0° 17′ | s. / |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.3010 | 1.2553 | 1.2139 | 1.1761 | 1.1413 | 1.1091 | 1.0792 | 1.0512 | 1.0248 | 0 |
| 1 | 1.3002 | 1.2545 | 1.2132 | 1.1755 | 1.1408 | 1.1086 | 1.0787 | 1.0507 | 1.0244 | 1 |
| 2 | 1.2994 | 1.2538 | 1.2126 | 1.1749 | 1.1402 | 1.1081 | 1.0782 | 1.0502 | 1.0240 | 2 |
| 3 | 1.2986 | 1.2531 | 1.2119 | 1.1743 | 1.1397 | 1.1076 | 1.0777 | 1.0498 | 1.0235 | 3 |
| 4 | 1.2978 | 1.2524 | 1.2113 | 1.1737 | 1.1391 | 1.1071 | 1.0773 | 1.0493 | 1.0231 | 4 |
| 5 | 1.2970 | 1.2517 | 1.2106 | 1.1731 | 1.1386 | 1.1066 | 1.0768 | 1.0489 | 1.0227 | 5 |
| 6 | 1.2962 | 1.2510 | 1.2099 | 1.1725 | 1.1380 | 1.1061 | 1.0763 | 1.0484 | 1.0223 | 6 |
| 7 | 1.2954 | 1.2502 | 1.2093 | 1.1719 | 1.1374 | 1.1055 | 1.0758 | 1.0480 | 1.0219 | 7 |
| 8 | 1.2946 | 1.2495 | 1.2086 | 1.1713 | 1.1369 | 1.1050 | 1.0753 | 1.0475 | 1.0214 | 8 |
| 9 | 1.2939 | 1.2488 | 1.2080 | 1.1707 | 1.1363 | 1.1045 | 1.0749 | 1.0471 | 1.0210 | 9 |
| 10 | 1.2931 | 1.2481 | 1.2073 | 1.1701 | 1.1358 | 1.1040 | 1.0744 | 1.0467 | 1.0206 | 10 |
| 11 | 1.2923 | 1.2474 | 1.2067 | 1.1695 | 1.1352 | 1.1035 | 1.0739 | 1.0462 | 1.0202 | 11 |
| 12 | 1.2915 | 1.2467 | 1.2061 | 1.1689 | 1.1347 | 1.1030 | 1.0734 | 1.0458 | 1.0197 | 12 |
| 13 | 1.2907 | 1.2460 | 1.2054 | 1.1683 | 1.1342 | 1.1025 | 1.0730 | 1.0453 | 1.0193 | 13 |
| 14 | 1.2899 | 1.2453 | 1.2048 | 1.1677 | 1.1336 | 1.1020 | 1.0725 | 1.0449 | 1.0189 | 14 |
| 15 | 1.2891 | 1.2445 | 1.2041 | 1.1671 | 1.1331 | 1.1015 | 1.0720 | 1.0444 | 1.0185 | 15 |
| 16 | 1.2883 | 1.2438 | 1.2035 | 1.1665 | 1.1325 | 1.1009 | 1.0715 | 1.0440 | 1.0181 | 16 |
| 17 | 1.2876 | 1.2431 | 1.2028 | 1.1660 | 1.1320 | 1.1004 | 1.0711 | 1.0435 | 1.0176 | 17 |
| 18 | 1.2868 | 1.2424 | 1.2022 | 1.1654 | 1.1314 | 1.0999 | 1.0706 | 1.0431 | 1.0172 | 18 |
| 19 | 1.2860 | 1.2417 | 1.2016 | 1.1648 | 1.1309 | 1.0994 | 1.0701 | 1.0426 | 1.0168 | 19 |
| 20 | 1.2852 | 1.2410 | 1.2009 | 1.1642 | 1.1303 | 1.0989 | 1.0696 | 1.0422 | 1.0164 | 20 |
| 21 | 1.2845 | 1.2403 | 1.2003 | 1.1636 | 1.1298 | 1.0984 | 1.0692 | 1.0418 | 1.0160 | 21 |
| 22 | 1.2837 | 1.2396 | 1.1996 | 1.1630 | 1.1292 | 1.0979 | 1.0687 | 1.0413 | 1.0156 | 22 |
| 23 | 1.2829 | 1.2389 | 1.1990 | 1.1624 | 1.1287 | 1.0974 | 1.0682 | 1.0409 | 1.0151 | 23 |
| 24 | 1.2821 | 1.2382 | 1.1984 | 1.1619 | 1.1282 | 1.0969 | 1.0678 | 1.0404 | 1.0147 | 24 |
| 25 | 1.2814 | 1.2375 | 1.1977 | 1.1613 | 1.1276 | 1.0964 | 1.0673 | 1.0400 | 1.0143 | 25 |
| 26 | 1.2806 | 1.2368 | 1.1971 | 1.1607 | 1.1271 | 1.0959 | 1.0668 | 1.0395 | 1.0139 | 26 |
| 27 | 1.2798 | 1.2362 | 1.1965 | 1.1601 | 1.1266 | 1.0954 | 1.0663 | 1.0391 | 1.0135 | 27 |
| 28 | 1.2791 | 1.2355 | 1.1958 | 1.1595 | 1.1260 | 1.0949 | 1.0659 | 1.0387 | 1.0131 | 28 |
| 29 | 1.2783 | 1.2348 | 1.1952 | 1.1589 | 1.1255 | 1.0944 | 1.0654 | 1.0382 | 1.0126 | 29 |
| 30 | 1.2775 | 1.2341 | 1.1946 | 1.1584 | 1.1249 | 1.0939 | 1.0649 | 1.0378 | 1.0122 | 30 |
| 31 | 1.2768 | 1.2334 | 1.1939 | 1.1578 | 1.1244 | 1.0934 | 1.0645 | 1.0374 | 1.0118 | 31 |
| 32 | 1.2760 | 1.2327 | 1.1933 | 1.1572 | 1.1239 | 1.0929 | 1.0640 | 1.0369 | 1.0114 | 32 |
| 33 | 1.2753 | 1.2320 | 1.1927 | 1.1566 | 1.1233 | 1.0924 | 1.0635 | 1.0365 | 1.0110 | 33 |
| 34 | 1.2745 | 1.2313 | 1.1921 | 1.1561 | 1.1228 | 1.0919 | 1.0631 | 1.0360 | 1.0106 | 34 |
| 35 | 1.2738 | 1.2307 | 1.1914 | 1.1555 | 1.1223 | 1.0914 | 1.0626 | 1.0356 | 1.0102 | 35 |
| 36 | 1.2730 | 1.2300 | 1.1908 | 1.1549 | 1.1217 | 1.0909 | 1.0621 | 1.0352 | 1.0098 | 36 |
| 37 | 1.2722 | 1.2293 | 1.1902 | 1.1543 | 1.1212 | 1.0904 | 1.0617 | 1.0347 | 1.0093 | 37 |
| 38 | 1.2715 | 1.2286 | 1.1896 | 1.1538 | 1.1207 | 1.0899 | 1.0612 | 1.0343 | 1.0089 | 38 |
| 39 | 1.2707 | 1.2279 | 1.1889 | 1.1532 | 1.1201 | 1.0894 | 1.0608 | 1.0339 | 1.0085 | 39 |
| 40 | 1.2700 | 1.2272 | 1.1883 | 1.1526 | 1.1196 | 1.0889 | 1.0603 | 1.0334 | 1.0081 | 40 |
| 41 | 1.2692 | 1.2266 | 1.1877 | 1.1520 | 1.1191 | 1.0884 | 1.0598 | 1.0330 | 1.0077 | 41 |
| 42 | 1.2685 | 1.2259 | 1.1871 | 1.1515 | 1.1186 | 1.0880 | 1.0594 | 1.0326 | 1.0073 | 42 |
| 43 | 1.2678 | 1.2252 | 1.1865 | 1.1509 | 1.1180 | 1.0875 | 1.0589 | 1.0321 | 1.0069 | 43 |
| 44 | 1.2670 | 1.2245 | 1.1858 | 1.1503 | 1.1175 | 1.0870 | 1.0585 | 1.0317 | 1.0065 | 44 |
| 45 | 1.2663 | 1.2239 | 1.1852 | 1.1498 | 1.1170 | 1.0865 | 1.0580 | 1.0313 | 1.0061 | 45 |
| 46 | 1.2655 | 1.2232 | 1.1846 | 1.1492 | 1.1164 | 1.0860 | 1.0575 | 1.0308 | 1.0057 | 46 |
| 47 | 1.2648 | 1.2225 | 1.1840 | 1.1486 | 1.1159 | 1.0855 | 1.0571 | 1.0304 | 1.0053 | 47 |
| 48 | 1.2640 | 1.2218 | 1.1834 | 1.1481 | 1.1154 | 1.0850 | 1.0566 | 1.0300 | 1.0049 | 48 |
| 49 | 1.2633 | 1.2212 | 1.1828 | 1.1475 | 1.1149 | 1.0845 | 1.0562 | 1.0295 | 1.0044 | 49 |
| 50 | 1.2626 | 1.2205 | 1.1822 | 1.1469 | 1.1143 | 1.0840 | 1.0557 | 1.0291 | 1.0040 | 50 |
| 51 | 1.2618 | 1.2198 | 1.1816 | 1.1464 | 1.1138 | 1.0835 | 1.0552 | 1.0287 | 1.0036 | 51 |
| 52 | 1.2611 | 1.2192 | 1.1809 | 1.1458 | 1.1133 | 1.0831 | 1.0548 | 1.0282 | 1.0032 | 52 |
| 53 | 1.2604 | 1.2185 | 1.1803 | 1.1452 | 1.1128 | 1.0826 | 1.0543 | 1.0278 | 1.0028 | 53 |
| 54 | 1.2596 | 1.2178 | 1.1797 | 1.1447 | 1.1123 | 1.0821 | 1.0539 | 1.0274 | 1.0024 | 54 |
| 55 | 1.2589 | 1.2172 | 1.1791 | 1.1441 | 1.1117 | 1.0816 | 1.0534 | 1.0270 | 1.0020 | 55 |
| 56 | 1.2582 | 1.2165 | 1.1785 | 1.1436 | 1.1112 | 1.0811 | 1.0530 | 1.0265 | 1.0016 | 56 |
| 57 | 1.2574 | 1.2159 | 1.1779 | 1.1430 | 1.1107 | 1.0806 | 1.0525 | 1.0261 | 1.0012 | 57 |
| 58 | 1.2567 | 1.2152 | 1.1773 | 1.1424 | 1.1102 | 1.0801 | 1.0521 | 1.0257 | 1.0008 | 58 |
| 59 | 1.2560 | 1.2145 | 1.1767 | 1.1419 | 1.1097 | 1.0797 | 1.0516 | 1.0252 | 1.0004 | 59 |
| 60 | 1.2553 | 1.2139 | 1.1761 | 1.1413 | 1.1091 | 1.0792 | 1.0512 | 1.0248 | 1.0000 | 60 |

## PROPORTIONAL LOGARITHMS.

| s. ″ | h. m. 0° 18′ | h. m. 0° 19′ | h. m. 0° 20′ | h. m. 0° 21′ | h. m. 0° 22′ | h. m. 0° 23′ | h. m. 0° 24′ | h. m. 0° 25′ | h. m 0° 26′ | h. m. 0° 27′ | h. m. 0° 28′ | h. m. 0° 29′ | s. ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10000 | 9765 | 9542 | 9331 | 9128 | 8935 | 8751 | 8573 | 8403 | 8239 | 8081 | 7929 | 0 |
| 1 | 9996 | 9761 | 9539 | 9327 | 9125 | 8932 | 8748 | 8570 | 8400 | 8236 | 8079 | 7926 | 1 |
| 2 | 9992 | 9758 | 9535 | 9324 | 9122 | 8929 | 8745 | 8568 | 8397 | 8234 | 8076 | 7924 | 2 |
| 3 | 9988 | 9754 | 9532 | 9320 | 9119 | 8926 | 8742 | 8565 | 8395 | 8231 | 8073 | 7921 | 3 |
| 4 | 9984 | 9750 | 9528 | 9317 | 9115 | 8923 | 8739 | 8562 | 8392 | 8228 | 8071 | 7919 | 4 |
| 5 | 9980 | 9746 | 9524 | 9313 | 9112 | 8920 | 8736 | 8559 | 8389 | 8226 | 8068 | 7916 | 5 |
| 6 | 9976 | 9742 | 9521 | 9310 | 9109 | 8917 | 8733 | 8556 | 8386 | 8223 | 8066 | 7914 | 6 |
| 7 | 9972 | 9739 | 9517 | 9306 | 9106 | 8913 | 8730 | 8553 | 8384 | 8220 | 8063 | 7911 | 7 |
| 8 | 9968 | 9735 | 9514 | 9303 | 9103 | 8910 | 8727 | 8550 | 8381 | 8218 | 8061 | 7909 | 8 |
| 9 | 9964 | 9731 | 9510 | 9300 | 9099 | 8907 | 8724 | 8547 | 8378 | 8215 | 8058 | 7906 | 9 |
| 10 | 9960 | 9727 | 9506 | 9296 | 9096 | 8904 | 8721 | 8544 | 8375 | 8212 | 8055 | 7904 | 10 |
| 11 | 9956 | 9723 | 9503 | 9293 | 9092 | 8901 | 8718 | 8542 | 8372 | 8210 | 8053 | 7901 | 11 |
| 12 | 9952 | 9720 | 9499 | 9289 | 9089 | 8898 | 8715 | 8539 | 8370 | 8207 | 8050 | 7899 | 12 |
| 13 | 9948 | 9716 | 9496 | 9286 | 9086 | 8895 | 8712 | 8536 | 8367 | 8204 | 8048 | 7896 | 13 |
| 14 | 9944 | 9712 | 9492 | 9283 | 9083 | 8892 | 8709 | 8533 | 8364 | 8202 | 8045 | 7894 | 14 |
| 15 | 9940 | 9708 | 9488 | 9279 | 9079 | 8888 | 8706 | 8530 | 8361 | 8199 | 8043 | 7891 | 15 |
| 16 | 9936 | 9705 | 9485 | 9276 | 9076 | 8885 | 8703 | 8527 | 8359 | 8196 | 8040 | 7889 | 16 |
| 17 | 9932 | 9701 | 9481 | 9272 | 9073 | 8882 | 8700 | 8524 | 8356 | 8194 | 8037 | 7887 | 17 |
| 18 | 9928 | 9697 | 9478 | 9269 | 9070 | 8879 | 8697 | 8522 | 8353 | 8191 | 8035 | 7884 | 18 |
| 19 | 9924 | 9693 | 9474 | 9266 | 9066 | 8876 | 8694 | 8519 | 8350 | 8188 | 8032 | 7882 | 19 |
| 20 | 9920 | 9690 | 9471 | 9262 | 9063 | 8873 | 8691 | 8516 | 8348 | 8186 | 8030 | 7879 | 20 |
| 21 | 9916 | 9686 | 9467 | 9259 | 9060 | 8870 | 8688 | 8513 | 8345 | 8183 | 8027 | 7877 | 21 |
| 22 | 9912 | 9682 | 9464 | 9255 | 9057 | 8867 | 8685 | 8510 | 8342 | 8181 | 8025 | 7874 | 22 |
| 23 | 9908 | 9678 | 9460 | 9252 | 9053 | 8864 | 8682 | 8507 | 8339 | 8178 | 8022 | 7872 | 23 |
| 24 | 9905 | 9675 | 9456 | 9249 | 9050 | 8861 | 8679 | 8504 | 8337 | 8175 | 8020 | 7869 | 24 |
| 25 | 9901 | 9671 | 9453 | 9245 | 9047 | 8857 | 8676 | 8502 | 8334 | 8173 | 8017 | 7867 | 25 |
| 26 | 9897 | 9667 | 9449 | 9242 | 9044 | 8854 | 8673 | 8499 | 8331 | 8170 | 8014 | 7864 | 26 |
| 27 | 9893 | 9664 | 9446 | 9238 | 9041 | 8851 | 8670 | 8496 | 8328 | 8167 | 8012 | 7862 | 27 |
| 28 | 9889 | 9660 | 9442 | 9235 | 9037 | 8848 | 8667 | 8493 | 8326 | 8165 | 8009 | 7859 | 28 |
| 29 | 9885 | 9656 | 9439 | 9232 | 9034 | 8845 | 8664 | 8490 | 8323 | 8162 | 8007 | 7857 | 29 |
| 30 | 9881 | 9652 | 9435 | 9228 | 9031 | 8842 | 8661 | 8487 | 8320 | 8159 | 8004 | 7855 | 30 |
| 31 | 9877 | 9649 | 9432 | 9225 | 9028 | 8839 | 8658 | 8484 | 8318 | 8157 | 8002 | 7852 | 31 |
| 32 | 9873 | 9645 | 9428 | 9222 | 9024 | 8836 | 8655 | 8482 | 8315 | 8154 | 7999 | 7850 | 32 |
| 33 | 9869 | 9641 | 9425 | 9218 | 9021 | 8833 | 8652 | 8479 | 8312 | 8152 | 7997 | 7847 | 33 |
| 34 | 9865 | 9638 | 9421 | 9215 | 9018 | 8830 | 8649 | 8476 | 8309 | 8149 | 7994 | 7845 | 34 |
| 35 | 9861 | 9634 | 9418 | 9212 | 9015 | 8827 | 8646 | 8473 | 8307 | 8146 | 7992 | 7842 | 35 |
| 36 | 9858 | 9630 | 9414 | 9208 | 9012 | 8824 | 8643 | 8470 | 8304 | 8144 | 7989 | 7840 | 36 |
| 37 | 9854 | 9626 | 9411 | 9205 | 9008 | 8821 | 8640 | 8467 | 8301 | 8141 | 7987 | 7837 | 37 |
| 38 | 9850 | 9623 | 9407 | 9201 | 9005 | 8817 | 8637 | 8465 | 8298 | 8138 | 7984 | 7835 | 38 |
| 39 | 9846 | 9619 | 9404 | 9198 | 9002 | 8814 | 8635 | 8462 | 8296 | 8136 | 7981 | 7832 | 39 |
| 40 | 9842 | 9615 | 9400 | 9195 | 8999 | 8811 | 8632 | 8459 | 8293 | 8133 | 7979 | 7830 | 40 |
| 41 | 9838 | 9612 | 9397 | 9191 | 8996 | 8808 | 8629 | 8456 | 8290 | 8131 | 7976 | 7828 | 41 |
| 42 | 9834 | 9608 | 9393 | 9188 | 8992 | 8805 | 8626 | 8453 | 8288 | 8128 | 7974 | 7825 | 42 |
| 43 | 9830 | 9604 | 9390 | 9185 | 8989 | 8802 | 8623 | 8451 | 8285 | 8125 | 7971 | 7823 | 43 |
| 44 | 9827 | 9601 | 9386 | 9181 | 8986 | 8799 | 8620 | 8448 | 8282 | 8123 | 7969 | 7820 | 44 |
| 45 | 9823 | 9597 | 9383 | 9178 | 8983 | 8796 | 8617 | 8445 | 8279 | 8120 | 7966 | 7818 | 45 |
| 46 | 9819 | 9593 | 9379 | 9175 | 8980 | 8793 | 8614 | 8442 | 8277 | 8117 | 7964 | 7815 | 46 |
| 47 | 9815 | 9590 | 9376 | 9172 | 8977 | 8790 | 8612 | 8439 | 8274 | 8115 | 7961 | 7813 | 47 |
| 48 | 9811 | 9586 | 9372 | 9168 | 8973 | 8787 | 8608 | 8437 | 8271 | 8112 | 7959 | 7811 | 48 |
| 49 | 9807 | 9582 | 9369 | 9165 | 8970 | 8784 | 8605 | 8434 | 8269 | 8110 | 7956 | 7808 | 49 |
| 50 | 9803 | 9579 | 9365 | 9162 | 8967 | 8781 | 8602 | 8431 | 8266 | 8107 | 7954 | 7806 | 50 |
| 51 | 9800 | 9575 | 9362 | 9158 | 8964 | 8778 | 8599 | 8428 | 8263 | 8104 | 7951 | 7803 | 51 |
| 52 | 9796 | 9571 | 9358 | 9155 | 8961 | 8775 | 8597 | 8425 | 8261 | 8102 | 7949 | 7801 | 52 |
| 53 | 9792 | 9568 | 9355 | 9152 | 8958 | 8772 | 8594 | 8423 | 8258 | 8099 | 7946 | 7798 | 53 |
| 54 | 9788 | 9564 | 9351 | 9148 | 8954 | 8769 | 8591 | 8420 | 8255 | 8097 | 7944 | 7796 | 54 |
| 55 | 9784 | 9561 | 9348 | 9145 | 8951 | 8766 | 8588 | 8417 | 8253 | 8094 | 7941 | 7794 | 55 |
| 56 | 9780 | 9557 | 9344 | 9142 | 8948 | 8763 | 8585 | 8414 | 8250 | 8091 | 7939 | 7791 | 56 |
| 57 | 9777 | 9553 | 9341 | 9138 | 8945 | 8760 | 8582 | 8411 | 8247 | 8089 | 7936 | 7789 | 57 |
| 58 | 9773 | 9550 | 9337 | 9135 | 8942 | 8757 | 8579 | 8409 | 8244 | 8086 | 7934 | 7786 | 58 |
| 59 | 9769 | 9546 | 9334 | 9132 | 8939 | 8754 | 8576 | 8406 | 8242 | 8084 | 7931 | 7784 | 59 |
| 60 | 9765 | 9542 | 9331 | 9128 | 8935 | 8751 | 8573 | 8403 | 8239 | 8081 | 7929 | 7782 | 60 |

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# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. ″ | h. m. 0° 30′ | h. m. 0° 31′ | h. m. 0° 32′ | h. m. 0° 33′ | h. m. 0° 34′ | h. m. 0° 35′ | h. m. 0° 36′ | h. m. 0° 37′ | h. m. 0° 38′ | h. m. 0° 39′ | h. m. 0° 40′ | h. m. 0° 41′ | s. ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7782 | 7639 | 7501 | 7368 | 7238 | 7112 | 6990 | 6871 | 6755 | 6642 | 6532 | 6425 | 0 |
| 1 | 7779 | 7637 | 7499 | 7365 | 7236 | 7110 | 6988 | 6869 | 6753 | 6640 | 6530 | 6423 | 1 |
| 2 | 7777 | 7634 | 7497 | 7363 | 7234 | 7108 | 6986 | 6867 | 6751 | 6638 | 6529 | 6421 | 2 |
| 3 | 7774 | 7632 | 7494 | 7361 | 7232 | 7106 | 6984 | 6865 | 6749 | 6637 | 6527 | 6420 | 3 |
| 4 | 7772 | 7630 | 7492 | 7359 | 7229 | 7104 | 6982 | 6863 | 6747 | 6635 | 6525 | 6418 | 4 |
| 5 | 7769 | 7627 | 7490 | 7357 | 7227 | 7102 | 6980 | 6861 | 6745 | 6633 | 6523 | 6416 | 5 |
| 6 | 7767 | 7625 | 7488 | 7354 | 7225 | 7100 | 6978 | 6859 | 6743 | 6631 | 6521 | 6414 | 6 |
| 7 | 7765 | 7623 | 7485 | 7352 | 7223 | 7098 | 6976 | 6857 | 6742 | 6629 | 6519 | 6413 | 7 |
| 8 | 7762 | 7620 | 7483 | 7350 | 7221 | 7096 | 6974 | 6855 | 6740 | 6627 | 6518 | 6411 | 8 |
| 9 | 7760 | 7618 | 7481 | 7348 | 7219 | 7093 | 6972 | 6853 | 6738 | 6625 | 6516 | 6409 | 9 |
| 10 | 7757 | 7616 | 7479 | 7346 | 7217 | 7091 | 6970 | 6851 | 6736 | 6624 | 6514 | 6407 | 10 |
| 11 | 7755 | 7613 | 7476 | 7344 | 7215 | 7089 | 6968 | 6849 | 6734 | 6622 | 6512 | 6406 | 11 |
| 12 | 7753 | 7611 | 7474 | 7341 | 7212 | 7087 | 6966 | 6847 | 6732 | 6620 | 6510 | 6404 | 12 |
| 13 | 7750 | 7609 | 7472 | 7339 | 7210 | 7085 | 6964 | 6845 | 6730 | 6618 | 6509 | 6402 | 13 |
| 14 | 7748 | 7607 | 7470 | 7337 | 7208 | 7083 | 6962 | 6843 | 6728 | 6616 | 6507 | 6400 | 14 |
| 15 | 7745 | 7604 | 7467 | 7335 | 7206 | 7081 | 6960 | 6841 | 6726 | 6614 | 6505 | 6398 | 15 |
| 16 | 7743 | 7602 | 7465 | 7333 | 7204 | 7079 | 6958 | 6840 | 6725 | 6612 | 6503 | 6397 | 16 |
| 17 | 7741 | 7600 | 7463 | 7330 | 7202 | 7077 | 6956 | 6838 | 6723 | 6611 | 6501 | 6395 | 17 |
| 18 | 7738 | 7597 | 7461 | 7328 | 7200 | 7075 | 6954 | 6836 | 6721 | 6609 | 6500 | 6393 | 18 |
| 19 | 7736 | 7595 | 7458 | 7326 | 7198 | 7073 | 6952 | 6834 | 6719 | 6607 | 6498 | 6391 | 19 |
| 20 | 7734 | 7593 | 7456 | 7324 | 7196 | 7071 | 6950 | 6832 | 6717 | 6605 | 6496 | 6390 | 20 |
| 21 | 7731 | 7590 | 7454 | 7322 | 7193 | 7069 | 6948 | 6830 | 6715 | 6603 | 6494 | 6388 | 21 |
| 22 | 7729 | 7588 | 7452 | 7320 | 7191 | 7067 | 6946 | 6828 | 6713 | 6601 | 6492 | 6386 | 22 |
| 23 | 7726 | 7586 | 7450 | 7317 | 7189 | 7065 | 6944 | 6826 | 6711 | 6600 | 6491 | 6384 | 23 |
| 24 | 7724 | 7583 | 7447 | 7315 | 7187 | 7063 | 6942 | 6824 | 6709 | 6598 | 6489 | 6383 | 24 |
| 25 | 7722 | 7581 | 7445 | 7313 | 7185 | 7061 | 6940 | 6822 | 6708 | 6596 | 6487 | 6381 | 25 |
| 26 | 7719 | 7579 | 7443 | 7311 | 7183 | 7059 | 6938 | 6820 | 6706 | 6594 | 6485 | 6379 | 26 |
| 27 | 7717 | 7577 | 7441 | 7309 | 7181 | 7057 | 6936 | 6818 | 6704 | 6592 | 6484 | 6377 | 27 |
| 28 | 7714 | 7574 | 7438 | 7307 | 7179 | 7055 | 6934 | 6816 | 6702 | 6590 | 6482 | 6376 | 28 |
| 29 | 7712 | 7572 | 7436 | 7304 | 7177 | 7052 | 6932 | 6814 | 6700 | 6589 | 6480 | 6374 | 29 |
| 30 | 7710 | 7570 | 7434 | 7302 | 7175 | 7050 | 6930 | 6812 | 6698 | 6587 | 6478 | 6372 | 30 |
| 31 | 7707 | 7567 | 7432 | 7300 | 7172 | 7048 | 6928 | 6810 | 6696 | 6585 | 6476 | 6371 | 31 |
| 32 | 7705 | 7565 | 7429 | 7298 | 7170 | 7046 | 6926 | 6809 | 6694 | 6583 | 6475 | 6369 | 32 |
| 33 | 7703 | 7563 | 7427 | 7296 | 7168 | 7044 | 6924 | 6807 | 6692 | 6581 | 6473 | 6367 | 33 |
| 34 | 7700 | 7560 | 7425 | 7294 | 7166 | 7042 | 6922 | 6805 | 6691 | 6579 | 6471 | 6365 | 34 |
| 35 | 7698 | 7558 | 7423 | 7291 | 7164 | 7040 | 6920 | 6803 | 6689 | 6578 | 6469 | 6364 | 35 |
| 36 | 7696 | 7556 | 7421 | 7289 | 7162 | 7038 | 6918 | 6801 | 6687 | 6576 | 6467 | 6362 | 36 |
| 37 | 7693 | 7554 | 7418 | 7287 | 7160 | 7036 | 6916 | 6799 | 6685 | 6574 | 6466 | 6360 | 37 |
| 38 | 7691 | 7551 | 7416 | 7285 | 7158 | 7034 | 6914 | 6797 | 6683 | 6572 | 6464 | 6358 | 38 |
| 39 | 7688 | 7549 | 7414 | 7283 | 7156 | 7032 | 6912 | 6795 | 6681 | 6570 | 6462 | 6357 | 39 |
| 40 | 7686 | 7547 | 7412 | 7281 | 7154 | 7030 | 6910 | 6793 | 6679 | 6568 | 6460 | 6355 | 40 |
| 41 | 7684 | 7544 | 7409 | 7279 | 7152 | 7028 | 6908 | 6791 | 6677 | 6567 | 6459 | 6353 | 41 |
| 42 | 7681 | 7542 | 7407 | 7276 | 7149 | 7026 | 6906 | 6789 | 6676 | 6565 | 6457 | 6351 | 42 |
| 43 | 7679 | 7540 | 7405 | 7274 | 7147 | 7024 | 6904 | 6787 | 6674 | 6563 | 6455 | 6350 | 43 |
| 44 | 7677 | 7538 | 7403 | 7272 | 7145 | 7022 | 6902 | 6785 | 6672 | 6561 | 6453 | 6348 | 44 |
| 45 | 7674 | 7535 | 7401 | 7270 | 7143 | 7020 | 6900 | 6784 | 6670 | 6559 | 6451 | 6346 | 45 |
| 46 | 7672 | 7533 | 7398 | 7268 | 7141 | 7018 | 6898 | 6782 | 6668 | 6558 | 6450 | 6344 | 46 |
| 47 | 7670 | 7531 | 7396 | 7266 | 7139 | 7016 | 6896 | 6780 | 6666 | 6556 | 6448 | 6343 | 47 |
| 48 | 7667 | 7528 | 7394 | 7264 | 7137 | 7014 | 6894 | 6778 | 6664 | 6554 | 6446 | 6341 | 48 |
| 49 | 7665 | 7526 | 7392 | 7261 | 7135 | 7012 | 6892 | 6776 | 6663 | 6552 | 6444 | 6339 | 49 |
| 50 | 7663 | 7524 | 7390 | 7259 | 7133 | 7010 | 6890 | 6774 | 6661 | 6550 | 6443 | 6338 | 50 |
| 51 | 7660 | 7522 | 7387 | 7257 | 7131 | 7008 | 6888 | 6772 | 6659 | 6548 | 6441 | 6336 | 51 |
| 52 | 7658 | 7519 | 7385 | 7255 | 7129 | 7006 | 6886 | 6770 | 6657 | 6547 | 6439 | 6334 | 52 |
| 53 | 7655 | 7517 | 7383 | 7253 | 7127 | 7004 | 6884 | 6768 | 6655 | 6545 | 6437 | 6332 | 53 |
| 54 | 7653 | 7515 | 7381 | 7251 | 7124 | 7002 | 6882 | 6766 | 6653 | 6543 | 6435 | 6331 | 54 |
| 55 | 7651 | 7513 | 7379 | 7249 | 7122 | 7000 | 6881 | 6764 | 6651 | 6541 | 6434 | 6329 | 55 |
| 56 | 7648 | 7510 | 7376 | 7246 | 7120 | 6998 | 6879 | 6763 | 6650 | 6539 | 6432 | 6327 | 56 |
| 57 | 7646 | 7508 | 7374 | 7244 | 7118 | 6996 | 6877 | 6761 | 6648 | 6538 | 6430 | 6325 | 57 |
| 58 | 7644 | 7506 | 7372 | 7242 | 7116 | 6994 | 6875 | 6759 | 6646 | 6536 | 6428 | 6324 | 58 |
| 59 | 7641 | 7503 | 7370 | 7240 | 7114 | 6992 | 6873 | 6757 | 6644 | 6534 | 6427 | 6322 | 59 |
| 60 | 7639 | 7501 | 7368 | 7238 | 7112 | 6990 | 6871 | 6755 | 6642 | 6532 | 6425 | 6320 | 60 |

## PROPORTIONAL LOGARITHMS.

| s. " | h. m. 0° 42′ | h. m. 0° 43′ | h. m. 0° 44′ | h. m. 0° 45′ | h. m. 0° 46′ | h. m. 0° 47′ | h. m. 0° 48′ | h. m. 0° 49′ | h. m. 0° 50′ | h. m. 0° 51′ | h. m. 0° 52′ | h. m. 0° 53′ | s. " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6220 | 6218 | 6118 | 6021 | 5925 | 5832 | 5740 | 5651 | 5563 | 5477 | 5393 | 5310 | 0 |
| 1 | 6319 | 6216 | 6117 | 6019 | 5924 | 5830 | 5739 | 5649 | 5562 | 5476 | 5391 | 5309 | 1 |
| 2 | 6317 | 6215 | 6115 | 6017 | 5922 | 5829 | 5737 | 5648 | 5560 | 5474 | 5390 | 5307 | 2 |
| 3 | 6315 | 6213 | 6113 | 6016 | 5920 | 5827 | 5736 | 5646 | 5559 | 5473 | 5389 | 5306 | 3 |
| 4 | 6313 | 6211 | 6112 | 6014 | 5919 | 5826 | 5734 | 5645 | 5557 | 5471 | 5387 | 5305 | 4 |
| 5 | 6312 | 6210 | 6110 | 6013 | 5917 | 5824 | 5733 | 5643 | 5556 | 5470 | 5386 | 5303 | 5 |
| 6 | 6310 | 6208 | 6108 | 6011 | 5916 | 5823 | 5731 | 5642 | 5554 | 5469 | 5384 | 5302 | 6 |
| 7 | 6308 | 6206 | 6107 | 6009 | 5914 | 5821 | 5730 | 5640 | 5553 | 5467 | 5383 | 5300 | 7 |
| 8 | 6306 | 6205 | 6105 | 6008 | 5913 | 5819 | 5728 | 5639 | 5551 | 5466 | 5382 | 5299 | 8 |
| 9 | 6305 | 6203 | 6103 | 6006 | 5911 | 5818 | 5727 | 5637 | 5550 | 5464 | 5380 | 5298 | 9 |
| 10 | 6303 | 6201 | 6102 | 6005 | 5909 | 5816 | 5725 | 5636 | 5549 | 5463 | 5379 | 5296 | 10 |
| 11 | 6301 | 6200 | 6100 | 6003 | 5908 | 5815 | 5724 | 5635 | 5547 | 5461 | 5377 | 5295 | 11 |
| 12 | 6300 | 6198 | 6099 | 6001 | 5906 | 5813 | 5722 | 5633 | 5546 | 5460 | 5376 | 5294 | 12 |
| 13 | 6298 | 6196 | 6097 | 6000 | 5905 | 5812 | 5721 | 5632 | 5544 | 5459 | 5375 | 5292 | 13 |
| 14 | 6296 | 6195 | 6095 | 5998 | 5903 | 5810 | 5719 | 5630 | 5543 | 5457 | 5373 | 5291 | 14 |
| 15 | 6294 | 6193 | 6094 | 5997 | 5902 | 5809 | 5718 | 5629 | 5541 | 5456 | 5372 | 5290 | 15 |
| 16 | 6293 | 6191 | 6092 | 5995 | 5900 | 5807 | 5716 | 5627 | 5540 | 5454 | 5370 | 5288 | 16 |
| 17 | 6291 | 6190 | 6090 | 5993 | 5898 | 5806 | 5715 | 5626 | 5538 | 5453 | 5369 | 5287 | 17 |
| 18 | 6289 | 6188 | 6089 | 5992 | 5897 | 5804 | 5713 | 5624 | 5537 | 5452 | 5368 | 5285 | 18 |
| 19 | 6288 | 6186 | 6087 | 5990 | 5895 | 5803 | 5712 | 5623 | 5536 | 5450 | 5366 | 5284 | 19 |
| 20 | 6286 | 6185 | 6085 | 5989 | 5894 | 5801 | 5710 | 5621 | 5534 | 5449 | 5365 | 5283 | 20 |
| 21 | 6284 | 6183 | 6084 | 5987 | 5892 | 5800 | 5709 | 5620 | 5533 | 5447 | 5364 | 5281 | 21 |
| 22 | 6282 | 6181 | 6082 | 5985 | 5891 | 5798 | 5707 | 5618 | 5531 | 5446 | 5362 | 5280 | 22 |
| 23 | 6281 | 6179 | 6081 | 5984 | 5889 | 5796 | 5706 | 5617 | 5530 | 5445 | 5361 | 5279 | 23 |
| 24 | 6279 | 6178 | 6079 | 5982 | 5888 | 5795 | 5704 | 5615 | 5528 | 5443 | 5359 | 5277 | 24 |
| 25 | 6277 | 6176 | 6077 | 5981 | 5886 | 5793 | 5703 | 5614 | 5527 | 5442 | 5358 | 5276 | 25 |
| 26 | 6276 | 6174 | 6076 | 5979 | 5884 | 5792 | 5701 | 5613 | 5526 | 5440 | 5357 | 5275 | 26 |
| 27 | 6274 | 6173 | 6074 | 5977 | 5883 | 5790 | 5700 | 5611 | 5524 | 5439 | 5356 | 5273 | 27 |
| 28 | 6272 | 6171 | 6072 | 5976 | 5881 | 5789 | 5698 | 5610 | 5522 | 5437 | 5354 | 5272 | 28 |
| 29 | 6271 | 6169 | 6071 | 5974 | 5880 | 5787 | 5697 | 5608 | 5521 | 5436 | 5353 | 5271 | 29 |
| 30 | 6269 | 6168 | 6069 | 5973 | 5878 | 5786 | 5695 | 5607 | 5520 | 5435 | 5351 | 5269 | 30 |
| 31 | 6267 | 6166 | 6067 | 5971 | 5877 | 5784 | 5694 | 5605 | 5518 | 5433 | 5350 | 5268 | 31 |
| 32 | 6265 | 6165 | 6066 | 5969 | 5875 | 5783 | 5692 | 5604 | 5517 | 5432 | 5348 | 5266 | 32 |
| 33 | 6264 | 6163 | 6064 | 5968 | 5874 | 5781 | 5691 | 5602 | 5516 | 5430 | 5347 | 5265 | 33 |
| 34 | 6262 | 6161 | 6063 | 5966 | 5872 | 5780 | 5689 | 5601 | 5514 | 5429 | 5346 | 5264 | 34 |
| 35 | 6260 | 6160 | 6061 | 5965 | 5870 | 5778 | 5688 | 5599 | 5513 | 5428 | 5344 | 5262 | 35 |
| 36 | 6259 | 6158 | 6059 | 5963 | 5869 | 5777 | 5686 | 5598 | 5511 | 5426 | 5343 | 5261 | 36 |
| 37 | 6257 | 6156 | 6058 | 5961 | 5867 | 5775 | 5685 | 5596 | 5510 | 5425 | 5341 | 5260 | 37 |
| 38 | 6255 | 6155 | 6056 | 5960 | 5866 | 5774 | 5683 | 5595 | 5508 | 5423 | 5340 | 5258 | 38 |
| 39 | 6254 | 6153 | 6055 | 5958 | 5864 | 5772 | 5682 | 5594 | 5507 | 5422 | 5339 | 5257 | 39 |
| 40 | 6252 | 6151 | 6053 | 5957 | 5863 | 5771 | 5680 | 5592 | 5506 | 5421 | 5337 | 5256 | 40 |
| 41 | 6250 | 6150 | 6051 | 5955 | 5861 | 5769 | 5679 | 5591 | 5504 | 5419 | 5336 | 5254 | 41 |
| 42 | 6248 | 6148 | 6050 | 5954 | 5860 | 5768 | 5677 | 5589 | 5503 | 5418 | 5335 | 5253 | 42 |
| 43 | 6247 | 6146 | 6048 | 5952 | 5858 | 5766 | 5676 | 5588 | 5501 | 5416 | 5333 | 5252 | 43 |
| 44 | 6245 | 6145 | 6046 | 5950 | 5856 | 5765 | 5674 | 5586 | 5500 | 5415 | 5332 | 5250 | 44 |
| 45 | 6243 | 6143 | 6045 | 5949 | 5855 | 5763 | 5673 | 5585 | 5498 | 5414 | 5331 | 5249 | 45 |
| 46 | 6242 | 6141 | 6043 | 5947 | 5853 | 5761 | 5671 | 5583 | 5497 | 5412 | 5329 | 5248 | 46 |
| 47 | 6240 | 6140 | 6042 | 5946 | 5852 | 5760 | 5670 | 5582 | 5496 | 5411 | 5328 | 5246 | 47 |
| 48 | 6238 | 6138 | 6040 | 5944 | 5850 | 5758 | 5669 | 5580 | 5494 | 5409 | 5326 | 5245 | 48 |
| 49 | 6237 | 6136 | 6038 | 5942 | 5849 | 5757 | 5667 | 5579 | 5493 | 5408 | 5325 | 5244 | 49 |
| 50 | 6235 | 6135 | 6037 | 5941 | 5847 | 5755 | 5666 | 5578 | 5491 | 5407 | 5324 | 5242 | 50 |
| 51 | 6233 | 6133 | 6035 | 5939 | 5846 | 5754 | 5664 | 5576 | 5490 | 5405 | 5322 | 5241 | 51 |
| 52 | 6232 | 6131 | 6033 | 5938 | 5844 | 5752 | 5663 | 5575 | 5488 | 5404 | 5321 | 5240 | 52 |
| 53 | 6230 | 6130 | 6032 | 5936 | 5843 | 5751 | 5661 | 5573 | 5487 | 5402 | 5320 | 5238 | 53 |
| 54 | 6228 | 6128 | 6030 | 5935 | 5841 | 5749 | 5660 | 5572 | 5486 | 5401 | 5318 | 5237 | 54 |
| 55 | 6226 | 6126 | 6029 | 5933 | 5839 | 5748 | 5658 | 5570 | 5484 | 5400 | 5317 | 5235 | 55 |
| 56 | 6225 | 6125 | 6027 | 5931 | 5838 | 5746 | 5657 | 5569 | 5483 | 5398 | 5315 | 5234 | 56 |
| 57 | 6223 | 6123 | 6025 | 5930 | 5836 | 5745 | 5655 | 5567 | 5481 | 5397 | 5314 | 5233 | 57 |
| 58 | 6221 | 6121 | 6024 | 5928 | 5835 | 5743 | 5654 | 5566 | 5480 | 5395 | 5313 | 5231 | 58 |
| 59 | 6220 | 6120 | 6022 | 5927 | 5833 | 5742 | 5652 | 5564 | 5478 | 5394 | 5311 | 5230 | 59 |
| 60 | 6218 | 6118 | 6021 | 5925 | 5832 | 5740 | 5651 | 5563 | 5477 | 5393 | 5310 | 5229 | 60 |

## PROPORTIONAL LOGARITHMS.

| s. | h. m. 0° 54′ | h. m. 0° 55′ | h. m. 0° 56′ | h. m. 0° 57′ | h. m. 0° 58′ | h. m. 0° 59′ | h. m. 1° 0′ | h. m. 1° 1′ | h. m. 1° 2′ | h. m. 1° 3′ | h. m. 1° 4′ | h. m. 1° 5′ | s. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5229 | 5149 | 5071 | 4994 | 4918 | 4844 | 4771 | 4699 | 4629 | 4559 | 4491 | 4424 | 0 |
| 1 | 5227 | 5148 | 5070 | 4993 | 4917 | 4843 | 4770 | 4698 | 4628 | 4558 | 4490 | 4422 | 1 |
| 2 | 5226 | 5146 | 5068 | 4991 | 4916 | 4842 | 4769 | 4697 | 4626 | 4557 | 4489 | 4421 | 2 |
| 3 | 5225 | 5145 | 5067 | 4990 | 4915 | 4841 | 4768 | 4696 | 4625 | 4556 | 4488 | 4420 | 3 |
| 4 | 5223 | 5144 | 5066 | 4989 | 4913 | 4839 | 4766 | 4695 | 4624 | 4555 | 4486 | 4419 | 4 |
| 5 | 5222 | 5143 | 5064 | 4988 | 4912 | 4838 | 4765 | 4693 | 4623 | 4554 | 4485 | 4418 | 5 |
| 6 | 5221 | 5141 | 5063 | 4986 | 4911 | 4837 | 4764 | 4692 | 4622 | 4552 | 4484 | 4417 | 6 |
| 7 | 5219 | 5140 | 5062 | 4985 | 4910 | 4836 | 4763 | 4691 | 4621 | 4551 | 4483 | 4416 | 7 |
| 8 | 5218 | 5139 | 5061 | 4984 | 4908 | 4834 | 4762 | 4690 | 4619 | 4550 | 4482 | 4415 | 8 |
| 9 | 5217 | 5137 | 5059 | 4983 | 4907 | 4833 | 4760 | 4689 | 4618 | 4549 | 4481 | 4414 | 9 |
| 10 | 5215 | 5136 | 5058 | 4981 | 4906 | 4832 | 4759 | 4688 | 4617 | 4548 | 4480 | 4412 | 10 |
| 11 | 5214 | 5135 | 5057 | 4980 | 4905 | 4831 | 4758 | 4686 | 4616 | 4547 | 4479 | 4411 | 11 |
| 12 | 5213 | 5133 | 5055 | 4979 | 4903 | 4830 | 4757 | 4685 | 4615 | 4546 | 4477 | 4410 | 12 |
| 13 | 5211 | 5132 | 5054 | 4977 | 4902 | 4828 | 4756 | 4684 | 4614 | 4544 | 4476 | 4409 | 13 |
| 14 | 5210 | 5131 | 5053 | 4976 | 4901 | 4827 | 4754 | 4683 | 4612 | 4543 | 4475 | 4408 | 14 |
| 15 | 5209 | 5129 | 5051 | 4975 | 4900 | 4826 | 4753 | 4682 | 4611 | 4542 | 4474 | 4407 | 15 |
| 16 | 5207 | 5128 | 5050 | 4974 | 4899 | 4825 | 4752 | 4680 | 4610 | 4541 | 4473 | 4406 | 16 |
| 17 | 5206 | 5127 | 5049 | 4972 | 4897 | 4823 | 4751 | 4679 | 4609 | 4540 | 4472 | 4405 | 17 |
| 18 | 5205 | 5125 | 5048 | 4971 | 4896 | 4822 | 4750 | 4678 | 4608 | 4539 | 4471 | 4404 | 18 |
| 19 | 5203 | 5124 | 5046 | 4970 | 4895 | 4821 | 4748 | 4677 | 4607 | 4538 | 4469 | 4402 | 19 |
| 20 | 5202 | 5123 | 5045 | 4969 | 4894 | 4820 | 4747 | 4676 | 4606 | 4536 | 4468 | 4401 | 20 |
| 21 | 5201 | 5122 | 5044 | 4967 | 4892 | 4819 | 4746 | 4675 | 4604 | 4535 | 4467 | 4400 | 21 |
| 22 | 5199 | 5120 | 5043 | 4966 | 4891 | 4817 | 4745 | 4673 | 4603 | 4534 | 4466 | 4399 | 22 |
| 23 | 5198 | 5119 | 5041 | 4965 | 4890 | 4816 | 4744 | 4672 | 4602 | 4533 | 4465 | 4398 | 23 |
| 24 | 5197 | 5118 | 5040 | 4964 | 4889 | 4815 | 4742 | 4671 | 4601 | 4532 | 4464 | 4397 | 24 |
| 25 | 5195 | 5116 | 5039 | 4962 | 4887 | 4814 | 4741 | 4670 | 4600 | 4531 | 4463 | 4396 | 25 |
| 26 | 5194 | 5115 | 5037 | 4961 | 4886 | 4812 | 4740 | 4669 | 4599 | 4530 | 4462 | 4395 | 26 |
| 27 | 5193 | 5114 | 5036 | 4960 | 4885 | 4811 | 4739 | 4668 | 4597 | 4528 | 4460 | 4394 | 27 |
| 28 | 5191 | 5112 | 5035 | 4959 | 4884 | 4810 | 4738 | 4666 | 4596 | 4527 | 4459 | 4393 | 28 |
| 29 | 5190 | 5111 | 5034 | 4957 | 4882 | 4809 | 4736 | 4665 | 4595 | 4526 | 4458 | 4391 | 29 |
| 30 | 5189 | 5110 | 5032 | 4956 | 4881 | 4808 | 4735 | 4664 | 4594 | 4525 | 4457 | 4390 | 30 |
| 31 | 5187 | 5108 | 5031 | 4955 | 4880 | 4806 | 4734 | 4663 | 4593 | 4524 | 4456 | 4389 | 31 |
| 32 | 5186 | 5107 | 5030 | 4954 | 4879 | 4805 | 4733 | 4662 | 4592 | 4523 | 4455 | 4388 | 32 |
| 33 | 5185 | 5106 | 5028 | 4952 | 4877 | 4804 | 4732 | 4660 | 4590 | 4522 | 4454 | 4387 | 33 |
| 34 | 5183 | 5105 | 5027 | 4951 | 4876 | 4803 | 4730 | 4659 | 4589 | 4520 | 4453 | 4386 | 34 |
| 35 | 5182 | 5103 | 5026 | 4950 | 4875 | 4801 | 4729 | 4658 | 4588 | 4519 | 4452 | 4385 | 35 |
| 36 | 5181 | 5102 | 5025 | 4949 | 4874 | 4800 | 4728 | 4657 | 4587 | 4518 | 4450 | 4384 | 36 |
| 37 | 5179 | 5101 | 5023 | 4947 | 4873 | 4799 | 4727 | 4656 | 4586 | 4517 | 4449 | 4383 | 37 |
| 38 | 5178 | 5099 | 5022 | 4946 | 4871 | 4798 | 4726 | 4655 | 4585 | 4516 | 4448 | 4381 | 38 |
| 39 | 5177 | 5098 | 5021 | 4945 | 4870 | 4797 | 4724 | 4653 | 4584 | 4515 | 4447 | 4380 | 39 |
| 40 | 5175 | 5097 | 5019 | 4943 | 4869 | 4795 | 4723 | 4652 | 4582 | 4514 | 4446 | 4379 | 40 |
| 41 | 5174 | 5095 | 5018 | 4942 | 4868 | 4794 | 4722 | 4651 | 4581 | 4512 | 4445 | 4378 | 41 |
| 42 | 5173 | 5094 | 5017 | 4941 | 4866 | 4793 | 4721 | 4650 | 4580 | 4511 | 4444 | 4377 | 42 |
| 43 | 5172 | 5093 | 5016 | 4940 | 4865 | 4792 | 4720 | 4649 | 4579 | 4510 | 4443 | 4376 | 43 |
| 44 | 5170 | 5092 | 5014 | 4938 | 4864 | 4791 | 4718 | 4648 | 4578 | 4509 | 4441 | 4375 | 44 |
| 45 | 5169 | 5090 | 5013 | 4937 | 4863 | 4789 | 4717 | 4646 | 4577 | 4508 | 4440 | 4374 | 45 |
| 46 | 5168 | 5089 | 5012 | 4936 | 4861 | 4788 | 4716 | 4645 | 4575 | 4507 | 4439 | 4373 | 46 |
| 47 | 5166 | 5088 | 5011 | 4935 | 4860 | 4787 | 4715 | 4644 | 4574 | 4506 | 4438 | 4372 | 47 |
| 48 | 5165 | 5086 | 5009 | 4933 | 4859 | 4786 | 4714 | 4643 | 4573 | 4505 | 4437 | 4370 | 48 |
| 49 | 5164 | 5085 | 5008 | 4932 | 4858 | 4785 | 4712 | 4642 | 4572 | 4503 | 4436 | 4369 | 49 |
| 50 | 5162 | 5084 | 5007 | 4931 | 4856 | 4783 | 4711 | 4640 | 4571 | 4502 | 4435 | 4368 | 50 |
| 51 | 5161 | 5082 | 5005 | 4930 | 4855 | 4782 | 4710 | 4639 | 4570 | 4501 | 4434 | 4367 | 51 |
| 52 | 5160 | 5081 | 5004 | 4928 | 4854 | 4781 | 4709 | 4638 | 4569 | 4500 | 4433 | 4366 | 52 |
| 53 | 5158 | 5080 | 5003 | 4927 | 4853 | 4780 | 4708 | 4637 | 4567 | 4499 | 4431 | 4365 | 53 |
| 54 | 5157 | 5079 | 5002 | 4926 | 4852 | 4778 | 4707 | 4636 | 4566 | 4498 | 4430 | 4364 | 54 |
| 55 | 5156 | 5077 | 5000 | 4925 | 4850 | 4777 | 4705 | 4635 | 4565 | 4497 | 4429 | 4363 | 55 |
| 56 | 5154 | 5076 | 4999 | 4923 | 4849 | 4776 | 4704 | 4633 | 4564 | 4495 | 4428 | 4362 | 56 |
| 57 | 5153 | 5075 | 4998 | 4922 | 4848 | 4775 | 4703 | 4632 | 4563 | 4494 | 4427 | 4361 | 57 |
| 58 | 5152 | 5073 | 4997 | 4921 | 4847 | 4774 | 4702 | 4631 | 4562 | 4493 | 4426 | 4359 | 58 |
| 59 | 5150 | 5072 | 4995 | 4920 | 4845 | 4772 | 4701 | 4630 | 4560 | 4492 | 4425 | 4358 | 59 |
| 60 | 5149 | 5071 | 4994 | 4918 | 4844 | 4771 | 4699 | 4629 | 4559 | 4491 | 4424 | 4357 | 60 |

## PROPORTIONAL LOGARITHMS.

| s. | h. m. 1° 6′ | h. m. 1° 7′ | h. m. 1° 8′ | h. m. 1° 9′ | h. m. 1° 10′ | h. m. 1° 11′ | h. m. 1° 12′ | h. m. 1° 13′ | h. m. 1° 14′ | h. m. 1° 15′ | h. m. 1° 16′ | h. m. 1° 17′ | s. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4357 | 4292 | 4228 | 4164 | 4102 | 4040 | 3979 | 3919 | 3860 | 3802 | 3745 | 3688 | 0 |
| 1 | 4356 | 4291 | 4227 | 4163 | 4101 | 4039 | 3978 | 3919 | 3859 | 3801 | 3744 | 3687 | 1 |
| 2 | 4355 | 4290 | 4226 | 4162 | 4100 | 4038 | 3977 | 3918 | 3858 | 3800 | 3743 | 3686 | 2 |
| 3 | 4354 | 4289 | 4224 | 4161 | 4099 | 4037 | 3976 | 3917 | 3857 | 3799 | 3742 | 3685 | 3 |
| 4 | 4353 | 4288 | 4223 | 4160 | 4098 | 4036 | 3975 | 3916 | 3856 | 3798 | 3741 | 3684 | 4 |
| 5 | 4352 | 4287 | 4222 | 4159 | 4097 | 4035 | 3974 | 3915 | 3856 | 3797 | 3740 | 3683 | 5 |
| 6 | 4351 | 4285 | 4221 | 4158 | 4096 | 4034 | 3973 | 3914 | 3855 | 3796 | 3739 | 3682 | 6 |
| 7 | 4350 | 4284 | 4220 | 4157 | 4095 | 4033 | 3972 | 3913 | 3854 | 3795 | 3738 | 3681 | 7 |
| 8 | 4349 | 4283 | 4219 | 4156 | 4093 | 4032 | 3971 | 3912 | 3853 | 3794 | 3737 | 3680 | 8 |
| 9 | 4347 | 4282 | 4218 | 4155 | 4092 | 4031 | 3970 | 3911 | 3852 | 3793 | 3736 | 3679 | 9 |
| 10 | 4346 | 4281 | 4217 | 4154 | 4091 | 4030 | 3969 | 3910 | 3851 | 3792 | 3735 | 3678 | 10 |
| 11 | 4345 | 4280 | 4216 | 4153 | 4090 | 4029 | 3968 | 3909 | 3850 | 3792 | 3734 | 3677 | 11 |
| 12 | 4344 | 4279 | 4215 | 4152 | 4089 | 4028 | 3967 | 3908 | 3849 | 3791 | 3733 | 3677 | 12 |
| 13 | 4343 | 4278 | 4214 | 4151 | 4088 | 4027 | 3966 | 3907 | 3848 | 3790 | 3732 | 3676 | 13 |
| 14 | 4342 | 4277 | 4213 | 4150 | 4087 | 4026 | 3965 | 3906 | 3847 | 3789 | 3731 | 3675 | 14 |
| 15 | 4341 | 4276 | 4212 | 4149 | 4086 | 4025 | 3964 | 3905 | 3846 | 3788 | 3730 | 3674 | 15 |
| 16 | 4340 | 4275 | 4211 | 4147 | 4085 | 4024 | 3963 | 3904 | 3845 | 3787 | 3729 | 3673 | 16 |
| 17 | 4339 | 4274 | 4210 | 4146 | 4084 | 4023 | 3962 | 3903 | 3844 | 3786 | 3728 | 3672 | 17 |
| 18 | 4338 | 4273 | 4209 | 4145 | 4083 | 4022 | 3961 | 3902 | 3843 | 3785 | 3727 | 3671 | 18 |
| 19 | 4336 | 4271 | 4207 | 4144 | 4082 | 4021 | 3960 | 3901 | 3842 | 3784 | 3727 | 3670 | 19 |
| 20 | 4335 | 4270 | 4206 | 4143 | 4081 | 4020 | 3959 | 3900 | 3841 | 3783 | 3726 | 3669 | 20 |
| 21 | 4334 | 4269 | 4205 | 4142 | 4080 | 4019 | 3958 | 3899 | 3840 | 3782 | 3725 | 3668 | 21 |
| 22 | 4333 | 4268 | 4204 | 4141 | 4079 | 4018 | 3957 | 3898 | 3839 | 3781 | 3724 | 3667 | 22 |
| 23 | 4332 | 4267 | 4203 | 4140 | 4078 | 4017 | 3956 | 3897 | 3838 | 3780 | 3723 | 3666 | 23 |
| 24 | 4331 | 4266 | 4202 | 4139 | 4077 | 4016 | 3955 | 3896 | 3837 | 3779 | 3722 | 3665 | 24 |
| 25 | 4330 | 4265 | 4201 | 4138 | 4076 | 4015 | 3954 | 3895 | 3836 | 3778 | 3721 | 3664 | 25 |
| 26 | 4329 | 4264 | 4200 | 4137 | 4075 | 4014 | 3953 | 3894 | 3835 | 3777 | 3720 | 3663 | 26 |
| 27 | 4328 | 4263 | 4199 | 4136 | 4074 | 4013 | 3952 | 3893 | 3834 | 3776 | 3719 | 3663 | 27 |
| 28 | 4327 | 4262 | 4198 | 4135 | 4073 | 4012 | 3951 | 3892 | 3833 | 3775 | 3718 | 3662 | 28 |
| 29 | 4326 | 4261 | 4197 | 4134 | 4072 | 4011 | 3950 | 3891 | 3832 | 3774 | 3717 | 3661 | 29 |
| 30 | 4325 | 4260 | 4196 | 4133 | 4071 | 4010 | 3949 | 3890 | 3831 | 3773 | 3716 | 3660 | 30 |
| 31 | 4323 | 4259 | 4195 | 4132 | 4070 | 4009 | 3948 | 3889 | 3830 | 3772 | 3715 | 3659 | 31 |
| 32 | 4322 | 4258 | 4194 | 4131 | 4069 | 4008 | 3947 | 3888 | 3829 | 3771 | 3714 | 3658 | 32 |
| 33 | 4321 | 4256 | 4193 | 4130 | 4068 | 4007 | 3946 | 3887 | 3828 | 3770 | 3713 | 3657 | 33 |
| 34 | 4320 | 4255 | 4192 | 4129 | 4067 | 4006 | 3945 | 3886 | 3827 | 3769 | 3712 | 3656 | 34 |
| 35 | 4319 | 4254 | 4191 | 4128 | 4066 | 4005 | 3944 | 3885 | 3826 | 3768 | 3711 | 3655 | 35 |
| 36 | 4318 | 4253 | 4189 | 4127 | 4065 | 4004 | 3943 | 3884 | 3825 | 3768 | 3710 | 3654 | 36 |
| 37 | 4317 | 4252 | 4188 | 4126 | 4064 | 4003 | 3942 | 3883 | 3824 | 3767 | 3709 | 3653 | 37 |
| 38 | 4316 | 4251 | 4187 | 4125 | 4063 | 4002 | 3941 | 3882 | 3823 | 3766 | 3709 | 3652 | 38 |
| 39 | 4315 | 4250 | 4186 | 4124 | 4062 | 4001 | 3940 | 3881 | 3822 | 3765 | 3708 | 3651 | 39 |
| 40 | 4314 | 4249 | 4185 | 4122 | 4061 | 4000 | 3939 | 3880 | 3821 | 3764 | 3707 | 3650 | 40 |
| 41 | 4313 | 4248 | 4184 | 4121 | 4060 | 3999 | 3938 | 3879 | 3820 | 3763 | 3706 | 3649 | 41 |
| 42 | 4311 | 4247 | 4183 | 4120 | 4059 | 3998 | 3937 | 3878 | 3820 | 3762 | 3705 | 3649 | 42 |
| 43 | 4310 | 4246 | 4182 | 4119 | 4058 | 3997 | 3936 | 3877 | 3819 | 3761 | 3704 | 3648 | 43 |
| 44 | 4309 | 4245 | 4181 | 4118 | 4056 | 3996 | 3935 | 3876 | 3818 | 3760 | 3703 | 3647 | 44 |
| 45 | 4308 | 4244 | 4180 | 4117 | 4055 | 3995 | 3934 | 3875 | 3817 | 3759 | 3702 | 3646 | 45 |
| 46 | 4307 | 4243 | 4179 | 4116 | 4054 | 3993 | 3933 | 3874 | 3816 | 3758 | 3701 | 3645 | 46 |
| 47 | 4306 | 4241 | 4178 | 4115 | 4053 | 3992 | 3932 | 3873 | 3815 | 3757 | 3700 | 3644 | 47 |
| 48 | 4305 | 4240 | 4177 | 4114 | 4052 | 3991 | 3931 | 3872 | 3814 | 3756 | 3699 | 3643 | 48 |
| 49 | 4304 | 4239 | 4176 | 4113 | 4051 | 3990 | 3930 | 3871 | 3813 | 3755 | 3698 | 3642 | 49 |
| 50 | 4303 | 4238 | 4175 | 4112 | 4050 | 3989 | 3929 | 3870 | 3812 | 3754 | 3697 | 3641 | 50 |
| 51 | 4302 | 4237 | 4174 | 4111 | 4049 | 3988 | 3928 | 3869 | 3811 | 3753 | 3696 | 3640 | 51 |
| 52 | 4301 | 4236 | 4173 | 4110 | 4048 | 3987 | 3927 | 3868 | 3810 | 3752 | 3695 | 3639 | 52 |
| 53 | 4300 | 4235 | 4172 | 4109 | 4047 | 3986 | 3926 | 3867 | 3809 | 3751 | 3694 | 3638 | 53 |
| 54 | 4298 | 4234 | 4171 | 4108 | 4046 | 3985 | 3925 | 3866 | 3808 | 3750 | 3693 | 3637 | 54 |
| 55 | 4297 | 4233 | 4169 | 4107 | 4045 | 3984 | 3924 | 3865 | 3807 | 3749 | 3693 | 3636 | 55 |
| 56 | 4296 | 4232 | 4168 | 4106 | 4044 | 3983 | 3923 | 3864 | 3806 | 3748 | 3692 | 3635 | 56 |
| 57 | 4295 | 4231 | 4167 | 4105 | 4043 | 3982 | 3922 | 3863 | 3805 | 3747 | 3691 | 3635 | 57 |
| 58 | 4294 | 4230 | 4166 | 4104 | 4042 | 3981 | 3921 | 3862 | 3804 | 3746 | 3690 | 3634 | 58 |
| 59 | 4293 | 4229 | 4165 | 4103 | 4041 | 3980 | 3920 | 3861 | 3803 | 3746 | 3689 | 3633 | 59 |
| 60 | 4292 | 4228 | 4164 | 4102 | 4040 | 3979 | 3919 | 3860 | 3802 | 3745 | 3688 | 3632 | 60 |

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## PROPORTIONAL LOGARITHMS.

| s. | h. m. 1° 18′ | h. m. 1° 19′ | h. m. 1° 20′ | h. m. 1° 21′ | h. m. 1° 22′ | h. m. 1° 23′ | h. m. 1° 24′ | h. m. 1° 25′ | h. m. 1° 26′ | h. m. 1° 27′ | h. m. 1° 28′ | h. m. 1° 29′ | s. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3632 | 3576 | 3522 | 3468 | 3415 | 3362 | 3310 | 3259 | 3208 | 3158 | 3108 | 3059 | 0 |
| 1 | 3631 | 3576 | 3521 | 3467 | 3414 | 3361 | 3309 | 3258 | 3207 | 3157 | 3107 | 3058 | 1 |
| 2 | 3630 | 3575 | 3520 | 3466 | 3413 | 3360 | 3308 | 3257 | 3206 | 3156 | 3106 | 3057 | 2 |
| 3 | 3629 | 3574 | 3519 | 3465 | 3412 | 3359 | 3307 | 3256 | 3205 | 3155 | 3105 | 3056 | 3 |
| 4 | 3628 | 3573 | 3518 | 3464 | 3411 | 3358 | 3306 | 3255 | 3204 | 3154 | 3105 | 3056 | 4 |
| 5 | 3627 | 3572 | 3517 | 3463 | 3410 | 3358 | 3306 | 3254 | 3204 | 3153 | 3104 | 3055 | 5 |
| 6 | 3626 | 3571 | 3516 | 3463 | 3409 | 3357 | 3305 | 3253 | 3203 | 3153 | 3103 | 3054 | 6 |
| 7 | 3625 | 3570 | 3515 | 3462 | 3408 | 3356 | 3304 | 3253 | 3202 | 3152 | 3102 | 3053 | 7 |
| 8 | 3624 | 3569 | 3514 | 3461 | 3408 | 3355 | 3303 | 3252 | 3201 | 3151 | 3101 | 3052 | 8 |
| 9 | 3623 | 3568 | 3514 | 3460 | 3407 | 3354 | 3302 | 3251 | 3200 | 3150 | 3101 | 3052 | 9 |
| 10 | 3623 | 3567 | 3513 | 3459 | 3406 | 3353 | 3301 | 3250 | 3199 | 3149 | 3100 | 3051 | 10 |
| 11 | 3622 | 3566 | 3512 | 3458 | 3405 | 3352 | 3300 | 3249 | 3198 | 3148 | 3099 | 3050 | 11 |
| 12 | 3621 | 3565 | 3511 | 3457 | 3404 | 3351 | 3300 | 3248 | 3198 | 3148 | 3098 | 3049 | 12 |
| 13 | 3620 | 3565 | 3510 | 3456 | 3403 | 3351 | 3299 | 3247 | 3197 | 3147 | 3097 | 3048 | 13 |
| 14 | 3619 | 3564 | 3509 | 3455 | 3402 | 3350 | 3298 | 3247 | 3196 | 3146 | 3096 | 3047 | 14 |
| 15 | 3618 | 3563 | 3508 | 3454 | 3401 | 3349 | 3297 | 3246 | 3195 | 3145 | 3096 | 3047 | 15 |
| 16 | 3617 | 3562 | 3507 | 3454 | 3400 | 3348 | 3296 | 3245 | 3194 | 3144 | 3095 | 3046 | 16 |
| 17 | 3616 | 3561 | 3506 | 3453 | 3400 | 3347 | 3295 | 3244 | 3193 | 3143 | 3094 | 3045 | 17 |
| 18 | 3615 | 3560 | 3506 | 3452 | 3399 | 3346 | 3294 | 3243 | 3193 | 3143 | 3093 | 3044 | 18 |
| 19 | 3614 | 3559 | 3505 | 3451 | 3398 | 3345 | 3294 | 3242 | 3192 | 3142 | 3092 | 3043 | 19 |
| 20 | 3613 | 3558 | 3504 | 3450 | 3397 | 3345 | 3293 | 3242 | 3191 | 3141 | 3091 | 3043 | 20 |
| 21 | 3612 | 3557 | 3503 | 3449 | 3396 | 3344 | 3292 | 3241 | 3190 | 3140 | 3091 | 3042 | 21 |
| 22 | 3611 | 3556 | 3502 | 3448 | 3395 | 3343 | 3291 | 3240 | 3189 | 3139 | 3090 | 3041 | 22 |
| 23 | 3610 | 3555 | 3501 | 3447 | 3394 | 3342 | 3290 | 3239 | 3188 | 3138 | 3089 | 3040 | 23 |
| 24 | 3610 | 3555 | 3500 | 3446 | 3393 | 3341 | 3289 | 3238 | 3188 | 3138 | 3088 | 3039 | 24 |
| 25 | 3609 | 3554 | 3499 | 3446 | 3393 | 3340 | 3288 | 3237 | 3187 | 3137 | 3087 | 3039 | 25 |
| 26 | 3608 | 3553 | 3498 | 3445 | 3392 | 3339 | 3288 | 3236 | 3186 | 3136 | 3087 | 3038 | 26 |
| 27 | 3607 | 3552 | 3497 | 3444 | 3391 | 3338 | 3287 | 3236 | 3185 | 3135 | 3086 | 3037 | 27 |
| 28 | 3606 | 3551 | 3497 | 3443 | 3390 | 3338 | 3286 | 3235 | 3184 | 3134 | 3085 | 3036 | 28 |
| 29 | 3605 | 3550 | 3496 | 3442 | 3389 | 3337 | 3285 | 3234 | 3183 | 3133 | 3084 | 3035 | 29 |
| 30 | 3604 | 3549 | 3495 | 3441 | 3388 | 3336 | 3284 | 3233 | 3183 | 3133 | 3083 | 3034 | 30 |
| 31 | 3603 | 3548 | 3494 | 3440 | 3387 | 3335 | 3283 | 3232 | 3182 | 3132 | 3082 | 3034 | 31 |
| 32 | 3602 | 3547 | 3493 | 3439 | 3386 | 3334 | 3282 | 3231 | 3181 | 3131 | 3082 | 3033 | 32 |
| 33 | 3601 | 3546 | 3492 | 3438 | 3386 | 3333 | 3282 | 3231 | 3180 | 3130 | 3081 | 3032 | 33 |
| 34 | 3600 | 3545 | 3491 | 3438 | 3385 | 3332 | 3281 | 3230 | 3179 | 3129 | 3080 | 3031 | 34 |
| 35 | 3599 | 3545 | 3490 | 3437 | 3384 | 3332 | 3280 | 3229 | 3178 | 3129 | 3079 | 3030 | 35 |
| 36 | 3598 | 3544 | 3489 | 3436 | 3383 | 3331 | 3279 | 3228 | 3178 | 3128 | 3078 | 3030 | 36 |
| 37 | 3598 | 3543 | 3488 | 3435 | 3382 | 3330 | 3278 | 3227 | 3177 | 3127 | 3078 | 3029 | 37 |
| 38 | 3597 | 3542 | 3488 | 3434 | 3381 | 3329 | 3277 | 3226 | 3176 | 3126 | 3077 | 3028 | 38 |
| 39 | 3596 | 3541 | 3487 | 3433 | 3380 | 3328 | 3276 | 3225 | 3175 | 3125 | 3076 | 3027 | 39 |
| 40 | 3595 | 3540 | 3486 | 3432 | 3379 | 3327 | 3276 | 3225 | 3174 | 3124 | 3075 | 3026 | 40 |
| 41 | 3594 | 3539 | 3485 | 3431 | 3379 | 3326 | 3275 | 3224 | 3173 | 3124 | 3074 | 3026 | 41 |
| 42 | 3593 | 3538 | 3484 | 3431 | 3378 | 3325 | 3274 | 3223 | 3173 | 3123 | 3073 | 3025 | 42 |
| 43 | 3592 | 3537 | 3483 | 3430 | 3377 | 3325 | 3273 | 3222 | 3172 | 3122 | 3073 | 3024 | 43 |
| 44 | 3591 | 3536 | 3482 | 3429 | 3376 | 3324 | 3272 | 3221 | 3171 | 3121 | 3072 | 3023 | 44 |
| 45 | 3590 | 3535 | 3481 | 3428 | 3375 | 3323 | 3271 | 3220 | 3170 | 3120 | 3071 | 3022 | 45 |
| 46 | 3589 | 3535 | 3480 | 3427 | 3374 | 3322 | 3270 | 3220 | 3169 | 3119 | 3070 | 3022 | 46 |
| 47 | 3588 | 3534 | 3480 | 3426 | 3373 | 3321 | 3270 | 3219 | 3168 | 3119 | 3069 | 3021 | 47 |
| 48 | 3587 | 3533 | 3479 | 3425 | 3372 | 3320 | 3269 | 3218 | 3168 | 3118 | 3069 | 3020 | 48 |
| 49 | 3587 | 3532 | 3478 | 3424 | 3372 | 3319 | 3268 | 3217 | 3167 | 3117 | 3068 | 3019 | 49 |
| 50 | 3586 | 3531 | 3477 | 3423 | 3371 | 3319 | 3267 | 3216 | 3166 | 3116 | 3067 | 3018 | 50 |
| 51 | 3585 | 3530 | 3476 | 3423 | 3370 | 3318 | 3266 | 3215 | 3165 | 3115 | 3066 | 3018 | 51 |
| 52 | 3584 | 3529 | 3475 | 3422 | 3369 | 3317 | 3265 | 3214 | 3164 | 3114 | 3065 | 3017 | 52 |
| 53 | 3583 | 3528 | 3474 | 3421 | 3368 | 3316 | 3265 | 3214 | 3163 | 3114 | 3065 | 3016 | 53 |
| 54 | 3582 | 3527 | 3473 | 3420 | 3367 | 3315 | 3264 | 3213 | 3163 | 3113 | 3064 | 3015 | 54 |
| 55 | 3581 | 3526 | 3472 | 3419 | 3366 | 3314 | 3263 | 3212 | 3162 | 3112 | 3063 | 3014 | 55 |
| 56 | 3580 | 3525 | 3471 | 3418 | 3365 | 3313 | 3262 | 3211 | 3161 | 3111 | 3062 | 3014 | 56 |
| 57 | 3579 | 3525 | 3471 | 3417 | 3365 | 3313 | 3261 | 3210 | 3160 | 3110 | 3061 | 3013 | 57 |
| 58 | 3578 | 3524 | 3470 | 3416 | 3364 | 3312 | 3260 | 3209 | 3159 | 3110 | 3060 | 3012 | 58 |
| 59 | 3577 | 3523 | 3469 | 3415 | 3363 | 3311 | 3259 | 3209 | 3158 | 3109 | 3060 | 3011 | 59 |
| 60 | 3576 | 3522 | 3468 | 3415 | 3362 | 3310 | 3259 | 3208 | 3158 | 3108 | 3059 | 3010 | 60 |

# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. ″ | h. m. 1° 30′ | h. m. 1° 31′ | h. m. 1° 32′ | h. m. 1° 33′ | h. m. 1° 34′ | h. m. 1° 35′ | h. m. 1° 36′ | h. m. 1° 37′ | h. m. 1° 38′ | h. m. 1° 39′ | h. m. 1° 40′ | h. m. 1° 41′ | s. ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3010 | 2962 | 2915 | 2868 | 2821 | 2775 | 2730 | 2685 | 2640 | 2596 | 2553 | 2510 | 0 |
| 1 | 3009 | 2962 | 2914 | 2867 | 2821 | 2775 | 2729 | 2684 | 2640 | 2596 | 2552 | 2509 | 1 |
| 2 | 3009 | 2961 | 2913 | 2866 | 2820 | 2774 | 2729 | 2684 | 2639 | 2595 | 2551 | 2508 | 2 |
| 3 | 3008 | 2960 | 2912 | 2866 | 2819 | 2773 | 2728 | 2683 | 2638 | 2594 | 2551 | 2507 | 3 |
| 4 | 3007 | 2959 | 2912 | 2865 | 2818 | 2772 | 2727 | 2682 | 2638 | 2593 | 2550 | 2507 | 4 |
| 5 | 3006 | 2958 | 2911 | 2864 | 2818 | 2772 | 2726 | 2681 | 2637 | 2593 | 2549 | 2506 | 5 |
| 6 | 3005 | 2958 | 2910 | 2863 | 2817 | 2771 | 2725 | 2681 | 2636 | 2592 | 2548 | 2505 | 6 |
| 7 | 3005 | 2957 | 2909 | 2862 | 2816 | 2770 | 2725 | 2680 | 2635 | 2591 | 2548 | 2504 | 7 |
| 8 | 3004 | 2956 | 2909 | 2862 | 2815 | 2769 | 2724 | 2679 | 2635 | 2591 | 2547 | 2504 | 8 |
| 9 | 3003 | 2955 | 2908 | 2861 | 2815 | 2769 | 2723 | 2678 | 2634 | 2590 | 2546 | 2503 | 9 |
| 10 | 3002 | 2954 | 2907 | 2860 | 2814 | 2768 | 2722 | 2678 | 2633 | 2589 | 2545 | 2502 | 10 |
| 11 | 3001 | 2954 | 2906 | 2859 | 2813 | 2767 | 2722 | 2677 | 2632 | 2588 | 2545 | 2502 | 11 |
| 12 | 3001 | 2953 | 2905 | 2859 | 2812 | 2766 | 2721 | 2676 | 2632 | 2588 | 2544 | 2501 | 12 |
| 13 | 3000 | 2952 | 2905 | 2858 | 2811 | 2766 | 2720 | 2675 | 2631 | 2587 | 2543 | 2500 | 13 |
| 14 | 2999 | 2951 | 2904 | 2857 | 2811 | 2765 | 2719 | 2675 | 2630 | 2586 | 2543 | 2499 | 14 |
| 15 | 2998 | 2950 | 2903 | 2856 | 2810 | 2764 | 2719 | 2674 | 2629 | 2585 | 2542 | 2499 | 15 |
| 16 | 2997 | 2950 | 2902 | 2855 | 2809 | 2763 | 2718 | 2673 | 2629 | 2585 | 2541 | 2498 | 16 |
| 17 | 2997 | 2949 | 2901 | 2855 | 2808 | 2763 | 2717 | 2672 | 2628 | 2584 | 2540 | 2497 | 17 |
| 18 | 2996 | 2948 | 2901 | 2854 | 2808 | 2762 | 2716 | 2672 | 2627 | 2583 | 2540 | 2497 | 18 |
| 19 | 2995 | 2947 | 2900 | 2853 | 2807 | 2761 | 2716 | 2671 | 2626 | 2583 | 2539 | 2496 | 19 |
| 20 | 2994 | 2946 | 2899 | 2852 | 2806 | 2760 | 2715 | 2670 | 2626 | 2582 | 2538 | 2495 | 20 |
| 21 | 2993 | 2946 | 2898 | 2852 | 2805 | 2760 | 2714 | 2669 | 2625 | 2581 | 2538 | 2494 | 21 |
| 22 | 2993 | 2945 | 2898 | 2851 | 2805 | 2759 | 2713 | 2669 | 2624 | 2580 | 2537 | 2494 | 22 |
| 23 | 2992 | 2944 | 2897 | 2850 | 2804 | 2758 | 2713 | 2668 | 2624 | 2580 | 2536 | 2493 | 23 |
| 24 | 2991 | 2943 | 2896 | 2849 | 2803 | 2757 | 2712 | 2667 | 2623 | 2579 | 2535 | 2492 | 24 |
| 25 | 2990 | 2942 | 2895 | 2848 | 2802 | 2756 | 2711 | 2666 | 2622 | 2578 | 2535 | 2492 | 25 |
| 26 | 2989 | 2942 | 2894 | 2848 | 2801 | 2756 | 2710 | 2666 | 2621 | 2577 | 2534 | 2491 | 26 |
| 27 | 2989 | 2941 | 2894 | 2847 | 2801 | 2755 | 2710 | 2665 | 2621 | 2577 | 2533 | 2490 | 27 |
| 28 | 2988 | 2940 | 2893 | 2846 | 2800 | 2754 | 2709 | 2664 | 2620 | 2576 | 2533 | 2489 | 28 |
| 29 | 2987 | 2939 | 2892 | 2845 | 2799 | 2753 | 2708 | 2663 | 2619 | 2575 | 2532 | 2489 | 29 |
| 30 | 2986 | 2939 | 2891 | 2845 | 2798 | 2753 | 2707 | 2663 | 2618 | 2574 | 2531 | 2488 | 30 |
| 31 | 2985 | 2938 | 2891 | 2844 | 2798 | 2752 | 2707 | 2662 | 2618 | 2574 | 2530 | 2487 | 31 |
| 32 | 2985 | 2937 | 2890 | 2843 | 2797 | 2751 | 2706 | 2661 | 2617 | 2573 | 2530 | 2487 | 32 |
| 33 | 2984 | 2936 | 2889 | 2842 | 2796 | 2750 | 2705 | 2660 | 2616 | 2572 | 2529 | 2486 | 33 |
| 34 | 2983 | 2935 | 2888 | 2842 | 2795 | 2750 | 2704 | 2660 | 2615 | 2572 | 2528 | 2485 | 34 |
| 35 | 2982 | 2935 | 2887 | 2841 | 2795 | 2749 | 2704 | 2659 | 2615 | 2571 | 2527 | 2485 | 35 |
| 36 | 2981 | 2934 | 2887 | 2840 | 2794 | 2748 | 2703 | 2658 | 2614 | 2570 | 2527 | 2484 | 36 |
| 37 | 2981 | 2933 | 2886 | 2839 | 2793 | 2747 | 2702 | 2657 | 2613 | 2569 | 2526 | 2483 | 37 |
| 38 | 2980 | 2932 | 2885 | 2838 | 2792 | 2747 | 2701 | 2657 | 2612 | 2569 | 2525 | 2482 | 38 |
| 39 | 2979 | 2931 | 2884 | 2838 | 2792 | 2746 | 2701 | 2656 | 2612 | 2568 | 2525 | 2482 | 39 |
| 40 | 2978 | 2931 | 2883 | 2837 | 2791 | 2745 | 2700 | 2655 | 2611 | 2567 | 2524 | 2481 | 40 |
| 41 | 2977 | 2930 | 2883 | 2836 | 2790 | 2744 | 2699 | 2655 | 2610 | 2566 | 2523 | 2480 | 41 |
| 42 | 2977 | 2929 | 2882 | 2835 | 2789 | 2744 | 2698 | 2654 | 2610 | 2566 | 2522 | 2480 | 42 |
| 43 | 2976 | 2928 | 2881 | 2835 | 2788 | 2743 | 2698 | 2653 | 2609 | 2565 | 2522 | 2479 | 43 |
| 44 | 2975 | 2927 | 2880 | 2834 | 2788 | 2742 | 2697 | 2652 | 2608 | 2564 | 2521 | 2478 | 44 |
| 45 | 2974 | 2927 | 2880 | 2833 | 2787 | 2741 | 2696 | 2652 | 2607 | 2564 | 2520 | 2477 | 45 |
| 46 | 2973 | 2926 | 2879 | 2832 | 2786 | 2741 | 2695 | 2651 | 2607 | 2563 | 2520 | 2477 | 46 |
| 47 | 2973 | 2925 | 2878 | 2831 | 2785 | 2740 | 2695 | 2650 | 2606 | 2562 | 2519 | 2476 | 47 |
| 48 | 2972 | 2924 | 2877 | 2831 | 2785 | 2739 | 2694 | 2649 | 2605 | 2561 | 2518 | 2475 | 48 |
| 49 | 2971 | 2924 | 2876 | 2830 | 2784 | 2738 | 2693 | 2649 | 2604 | 2561 | 2517 | 2475 | 49 |
| 50 | 2970 | 2923 | 2876 | 2829 | 2783 | 2738 | 2692 | 2648 | 2604 | 2560 | 2517 | 2474 | 50 |
| 51 | 2969 | 2922 | 2875 | 2828 | 2782 | 2737 | 2692 | 2647 | 2603 | 2559 | 2516 | 2473 | 51 |
| 52 | 2969 | 2921 | 2874 | 2828 | 2782 | 2736 | 2691 | 2646 | 2602 | 2559 | 2515 | 2472 | 52 |
| 53 | 2968 | 2920 | 2873 | 2827 | 2781 | 2735 | 2690 | 2646 | 2601 | 2558 | 2515 | 2472 | 53 |
| 54 | 2967 | 2920 | 2873 | 2826 | 2780 | 2735 | 2689 | 2645 | 2601 | 2557 | 2514 | 2471 | 54 |
| 55 | 2966 | 2919 | 2872 | 2825 | 2779 | 2734 | 2689 | 2644 | 2600 | 2556 | 2513 | 2470 | 55 |
| 56 | 2965 | 2918 | 2871 | 2825 | 2779 | 2733 | 2688 | 2643 | 2599 | 2556 | 2512 | 2470 | 56 |
| 57 | 2965 | 2917 | 2870 | 2824 | 2778 | 2732 | 2687 | 2643 | 2599 | 2555 | 2512 | 2469 | 57 |
| 58 | 2964 | 2916 | 2869 | 2823 | 2777 | 2732 | 2687 | 2642 | 2598 | 2554 | 2511 | 2468 | 58 |
| 59 | 2963 | 2916 | 2869 | 2822 | 2776 | 2731 | 2686 | 2641 | 2597 | 2553 | 2510 | 2467 | 59 |

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# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. # | h. m. 1° 42′ | h. m. 1° 43′ | h. m. 1° 44′ | h. m. 1° 45′ | h. m. 1° 46′ | h. m. 1° 47′ | h. m. 1° 48′ | h. m. 1° 49′ | h. m. 1° 50′ | h. m. 1° 51′ | h. m. 1° 52′ | h. m. 1° 53′ | s. # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2467 | 2424 | 2382 | 2341 | 2300 | 2259 | 2218 | 2178 | 2139 | 2099 | 2061 | 2022 | 0 |
| 1 | 2466 | 2424 | 2382 | 2340 | 2299 | 2258 | 2218 | 2178 | 2138 | 2099 | 2060 | 2021 | 1 |
| 2 | 2465 | 2423 | 2381 | 2339 | 2298 | 2258 | 2217 | 2177 | 2137 | 2098 | 2059 | 2021 | 2 |
| 3 | 2465 | 2422 | 2380 | 2339 | 2298 | 2257 | 2216 | 2176 | 2137 | 2098 | 2059 | 2020 | 3 |
| 4 | 2464 | 2422 | 2380 | 2338 | 2297 | 2256 | 2216 | 2176 | 2136 | 2097 | 2058 | 2019 | 4 |
| 5 | 2463 | 2421 | 2379 | 2337 | 2296 | 2256 | 2215 | 2175 | 2136 | 2096 | 2057 | 2019 | 5 |
| 6 | 2462 | 2420 | 2378 | 2337 | 2296 | 2255 | 2214 | 2174 | 2135 | 2096 | 2057 | 2018 | 6 |
| 7 | 2462 | 2419 | 2378 | 2336 | 2295 | 2254 | 2214 | 2174 | 2134 | 2095 | 2056 | 2017 | 7 |
| 8 | 2461 | 2419 | 2377 | 2335 | 2294 | 2253 | 2213 | 2173 | 2134 | 2094 | 2055 | 2017 | 8 |
| 9 | 2460 | 2418 | 2376 | 2335 | 2294 | 2253 | 2212 | 2172 | 2133 | 2094 | 2055 | 2016 | 9 |
| 10 | 2460 | 2417 | 2375 | 2334 | 2293 | 2252 | 2212 | 2172 | 2132 | 2093 | 2054 | 2016 | 10 |
| 11 | 2459 | 2417 | 2375 | 2333 | 2292 | 2251 | 2211 | 2171 | 2132 | 2092 | 2053 | 2015 | 11 |
| 12 | 2458 | 2416 | 2374 | 2333 | 2291 | 2251 | 2210 | 2170 | 2131 | 2092 | 2053 | 2014 | 12 |
| 13 | 2458 | 2415 | 2373 | 2332 | 2291 | 2250 | 2210 | 2170 | 2130 | 2091 | 2052 | 2014 | 13 |
| 14 | 2457 | 2415 | 2373 | 2331 | 2290 | 2249 | 2209 | 2169 | 2130 | 2090 | 2052 | 2013 | 14 |
| 15 | 2456 | 2414 | 2372 | 2331 | 2289 | 2249 | 2208 | 2169 | 2129 | 2090 | 2051 | 2012 | 15 |
| 16 | 2455 | 2413 | 2371 | 2330 | 2289 | 2248 | 2208 | 2168 | 2128 | 2089 | 2050 | 2012 | 16 |
| 17 | 2455 | 2412 | 2371 | 2329 | 2288 | 2247 | 2207 | 2167 | 2128 | 2088 | 2050 | 2011 | 17 |
| 18 | 2454 | 2412 | 2370 | 2328 | 2287 | 2247 | 2206 | 2167 | 2127 | 2088 | 2049 | 2010 | 18 |
| 19 | 2453 | 2411 | 2369 | 2328 | 2287 | 2246 | 2206 | 2166 | 2126 | 2087 | 2048 | 2010 | 19 |
| 20 | 2453 | 2410 | 2368 | 2327 | 2286 | 2245 | 2205 | 2165 | 2126 | 2086 | 2048 | 2009 | 20 |
| 21 | 2452 | 2410 | 2368 | 2326 | 2285 | 2245 | 2204 | 2165 | 2125 | 2086 | 2047 | 2009 | 21 |
| 22 | 2451 | 2409 | 2367 | 2326 | 2285 | 2244 | 2204 | 2164 | 2124 | 2085 | 2046 | 2008 | 22 |
| 23 | 2450 | 2408 | 2366 | 2325 | 2284 | 2243 | 2203 | 2163 | 2124 | 2085 | 2046 | 2007 | 23 |
| 24 | 2450 | 2408 | 2366 | 2324 | 2283 | 2243 | 2202 | 2163 | 2123 | 2084 | 2045 | 2007 | 24 |
| 25 | 2449 | 2407 | 2365 | 2324 | 2283 | 2242 | 2202 | 2162 | 2122 | 2083 | 2044 | 2006 | 25 |
| 26 | 2448 | 2406 | 2364 | 2323 | 2282 | 2241 | 2201 | 2161 | 2122 | 2083 | 2044 | 2005 | 26 |
| 27 | 2448 | 2405 | 2364 | 2322 | 2281 | 2241 | 2200 | 2161 | 2121 | 2082 | 2043 | 2005 | 27 |
| 28 | 2447 | 2405 | 2363 | 2322 | 2281 | 2240 | 2200 | 2160 | 2120 | 2081 | 2042 | 2004 | 28 |
| 29 | 2446 | 2404 | 2362 | 2321 | 2280 | 2239 | 2199 | 2159 | 2120 | 2081 | 2042 | 2003 | 29 |
| 30 | 2445 | 2403 | 2362 | 2320 | 2279 | 2239 | 2198 | 2159 | 2119 | 2080 | 2041 | 2003 | 30 |
| 31 | 2445 | 2403 | 2361 | 2320 | 2279 | 2238 | 2198 | 2158 | 2118 | 2079 | 2041 | 2002 | 31 |
| 32 | 2444 | 2402 | 2360 | 2319 | 2278 | 2237 | 2197 | 2157 | 2118 | 2079 | 2040 | 2001 | 32 |
| 33 | 2443 | 2401 | 2359 | 2318 | 2277 | 2237 | 2196 | 2157 | 2117 | 2078 | 2039 | 2001 | 33 |
| 34 | 2443 | 2401 | 2359 | 2317 | 2277 | 2236 | 2196 | 2156 | 2116 | 2077 | 2039 | 2000 | 34 |
| 35 | 2442 | 2400 | 2358 | 2317 | 2276 | 2235 | 2195 | 2155 | 2116 | 2077 | 2038 | 2000 | 35 |
| 36 | 2441 | 2399 | 2357 | 2316 | 2275 | 2235 | 2194 | 2155 | 2115 | 2076 | 2037 | 1999 | 36 |
| 37 | 2441 | 2398 | 2357 | 2315 | 2274 | 2234 | 2194 | 2154 | 2115 | 2075 | 2037 | 1998 | 37 |
| 38 | 2440 | 2398 | 2356 | 2315 | 2274 | 2233 | 2193 | 2153 | 2114 | 2075 | 2036 | 1998 | 38 |
| 39 | 2439 | 2397 | 2355 | 2314 | 2273 | 2233 | 2192 | 2153 | 2113 | 2074 | 2035 | 1997 | 39 |
| 40 | 2438 | 2396 | 2355 | 2313 | 2272 | 2232 | 2192 | 2152 | 2113 | 2073 | 2035 | 1996 | 40 |
| 41 | 2438 | 2396 | 2354 | 2313 | 2272 | 2231 | 2191 | 2151 | 2112 | 2073 | 2034 | 1996 | 41 |
| 42 | 2437 | 2395 | 2353 | 2312 | 2271 | 2231 | 2190 | 2151 | 2111 | 2072 | 2033 | 1995 | 42 |
| 43 | 2436 | 2394 | 2353 | 2311 | 2270 | 2230 | 2190 | 2150 | 2111 | 2072 | 2033 | 1994 | 43 |
| 44 | 2436 | 2394 | 2352 | 2311 | 2270 | 2229 | 2189 | 2149 | 2110 | 2071 | 2032 | 1994 | 44 |
| 45 | 2435 | 2393 | 2351 | 2310 | 2269 | 2229 | 2188 | 2149 | 2109 | 2070 | 2032 | 1993 | 45 |
| 46 | 2434 | 2392 | 2350 | 2309 | 2268 | 2228 | 2188 | 2148 | 2109 | 2070 | 2031 | 1993 | 46 |
| 47 | 2433 | 2391 | 2350 | 2309 | 2268 | 2227 | 2187 | 2147 | 2108 | 2069 | 2030 | 1992 | 47 |
| 48 | 2433 | 2391 | 2349 | 2308 | 2267 | 2227 | 2186 | 2147 | 2107 | 2068 | 2030 | 1991 | 48 |
| 49 | 2432 | 2390 | 2348 | 2307 | 2266 | 2226 | 2186 | 2146 | 2107 | 2068 | 2029 | 1991 | 49 |
| 50 | 2431 | 2389 | 2348 | 2307 | 2266 | 2225 | 2185 | 2145 | 2106 | 2067 | 2028 | 1990 | 50 |
| 51 | 2431 | 2389 | 2347 | 2306 | 2265 | 2225 | 2184 | 2145 | 2105 | 2066 | 2028 | 1989 | 51 |
| 52 | 2430 | 2388 | 2346 | 2305 | 2264 | 2224 | 2184 | 2144 | 2105 | 2066 | 2027 | 1989 | 52 |
| 53 | 2429 | 2387 | 2346 | 2304 | 2264 | 2223 | 2183 | 2143 | 2104 | 2065 | 2026 | 1988 | 53 |
| 54 | 2429 | 2387 | 2345 | 2304 | 2263 | 2223 | 2182 | 2143 | 2103 | 2064 | 2026 | 1987 | 54 |
| 55 | 2428 | 2386 | 2344 | 2303 | 2262 | 2222 | 2182 | 2142 | 2103 | 2064 | 2025 | 1987 | 55 |
| 56 | 2427 | 2385 | 2344 | 2302 | 2262 | 2221 | 2181 | 2141 | 2102 | 2063 | 2025 | 1986 | 56 |
| 57 | 2426 | 2384 | 2343 | 2302 | 2261 | 2220 | 2180 | 2141 | 2101 | 2062 | 2024 | 1986 | 57 |
| 58 | 2426 | 2384 | 2342 | 2301 | 2260 | 2220 | 2180 | 2140 | 2101 | 2062 | 2023 | 1985 | 58 |
| 59 | 2425 | 2383 | 2342 | 2300 | 2260 | 2219 | 2179 | 2139 | 2100 | 2061 | 2023 | 1984 | 59 |
| 60 | 2424 | 2382 | 2341 | 2300 | 2259 | 2218 | 2178 | 2139 | 2099 | 2061 | 2022 | 1984 | 60 |

# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. " | h. m. 1° 54′ | h. m. 1° 55′ | h. m. 1° 56′ | h. m. 1° 57′ | h. m. 1 58′ | h. m. 1° 59′ | h. m. 2° 0′ | h. m. 2° 1′ | h. m. 2° 2′ | h. m. 2° 3′ | h. m. 2° 4′ | s. ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1984 | 1946 | 1908 | 1871 | 1834 | 1797 | 1761 | 1725 | 1689 | 1654 | 1619 | 0 |
| 1 | 1983 | 1945 | 1908 | 1870 | 1833 | 1797 | 1760 | 1724 | 1689 | 1653 | 1618 | 1 |
| 2 | 1982 | 1944 | 1907 | 1870 | 1833 | 1796 | 1760 | 1724 | 1688 | 1652 | 1617 | 2 |
| 3 | 1982 | 1944 | 1906 | 1869 | 1832 | 1795 | 1759 | 1723 | 1687 | 1652 | 1617 | 3 |
| 4 | 1981 | 1943 | 1906 | 1868 | 1831 | 1795 | 1759 | 1722 | 1687 | 1651 | 1616 | 4 |
| 5 | 1981 | 1943 | 1905 | 1868 | 1831 | 1794 | 1758 | 1722 | 1686 | 1651 | 1616 | 5 |
| 6 | 1980 | 1942 | 1904 | 1867 | 1830 | 1794 | 1757 | 1721 | 1686 | 1650 | 1615 | 6 |
| 7 | 1979 | 1941 | 1904 | 1867 | 1830 | 1793 | 1757 | 1721 | 1685 | 1650 | 1614 | 7 |
| 8 | 1979 | 1941 | 1903 | 1866 | 1829 | 1792 | 1756 | 1720 | 1684 | 1649 | 1614 | 8 |
| 9 | 1978 | 1940 | 1903 | 1865 | 1828 | 1792 | 1755 | 1719 | 1684 | 1648 | 1613 | 9 |
| 10 | 1977 | 1939 | 1902 | 1865 | 1828 | 1791 | 1755 | 1719 | 1683 | 1648 | 1613 | 10 |
| 11 | 1977 | 1939 | 1901 | 1864 | 1827 | 1791 | 1754 | 1718 | 1683 | 1647 | 1612 | 11 |
| 12 | 1976 | 1938 | 1901 | 1863 | 1827 | 1790 | 1754 | 1718 | 1682 | 1647 | 1612 | 12 |
| 13 | 1975 | 1938 | 1900 | 1863 | 1826 | 1789 | 1753 | 1717 | 1681 | 1646 | 1611 | 13 |
| 14 | 1975 | 1937 | 1899 | 1862 | 1825 | 1789 | 1752 | 1717 | 1681 | 1645 | 1610 | 14 |
| 15 | 1974 | 1936 | 1899 | 1862 | 1825 | 1788 | 1752 | 1716 | 1680 | 1645 | 1610 | 15 |
| 16 | 1974 | 1936 | 1898 | 1861 | 1824 | 1788 | 1751 | 1715 | 1680 | 1644 | 1609 | 16 |
| 17 | 1973 | 1935 | 1898 | 1860 | 1823 | 1787 | 1751 | 1715 | 1679 | 1644 | 1609 | 17 |
| 18 | 1972 | 1934 | 1897 | 1860 | 1823 | 1786 | 1750 | 1714 | 1678 | 1643 | 1608 | 18 |
| 19 | 1972 | 1934 | 1896 | 1859 | 1822 | 1786 | 1749 | 1714 | 1678 | 1643 | 1607 | 19 |
| 20 | 1971 | 1933 | 1896 | 1859 | 1822 | 1785 | 1749 | 1713 | 1677 | 1642 | 1607 | 20 |
| 21 | 1970 | 1933 | 1895 | 1858 | 1821 | 1785 | 1748 | 1712 | 1677 | 1641 | 1606 | 21 |
| 22 | 1970 | 1932 | 1894 | 1857 | 1820 | 1784 | 1748 | 1712 | 1676 | 1641 | 1606 | 22 |
| 23 | 1969 | 1931 | 1894 | 1857 | 1820 | 1783 | 1747 | 1711 | 1676 | 1640 | 1605 | 23 |
| 24 | 1968 | 1931 | 1893 | 1856 | 1819 | 1783 | 1746 | 1711 | 1675 | 1640 | 1605 | 24 |
| 25 | 1968 | 1930 | 1893 | 1855 | 1819 | 1782 | 1746 | 1710 | 1674 | 1639 | 1604 | 25 |
| 26 | 1967 | 1929 | 1892 | 1855 | 1818 | 1781 | 1745 | 1709 | 1674 | 1638 | 1603 | 26 |
| 27 | 1967 | 1929 | 1891 | 1854 | 1817 | 1781 | 1745 | 1709 | 1673 | 1638 | 1603 | 27 |
| 28 | 1966 | 1928 | 1891 | 1854 | 1817 | 1780 | 1744 | 1708 | 1673 | 1637 | 1602 | 28 |
| 29 | 1965 | 1928 | 1890 | 1853 | 1816 | 1780 | 1743 | 1708 | 1672 | 1637 | 1602 | 29 |
| 30 | 1965 | 1927 | 1889 | 1852 | 1816 | 1779 | 1743 | 1707 | 1671 | 1636 | 1601 | 30 |
| 31 | 1964 | 1926 | 1889 | 1852 | 1815 | 1778 | 1742 | 1706 | 1671 | 1635 | 1600 | 31 |
| 32 | 1963 | 1926 | 1888 | 1851 | 1814 | 1778 | 1742 | 1706 | 1670 | 1635 | 1600 | 32 |
| 33 | 1963 | 1925 | 1888 | 1850 | 1814 | 1777 | 1741 | 1705 | 1670 | 1634 | 1599 | 33 |
| 34 | 1962 | 1924 | 1887 | 1850 | 1813 | 1777 | 1740 | 1705 | 1669 | 1634 | 1599 | 34 |
| 35 | 1962 | 1924 | 1886 | 1849 | 1812 | 1776 | 1740 | 1704 | 1668 | 1633 | 1598 | 35 |
| 36 | 1961 | 1923 | 1886 | 1849 | 1812 | 1775 | 1739 | 1703 | 1668 | 1633 | 1598 | 36 |
| 37 | 1960 | 1923 | 1885 | 1848 | 1811 | 1775 | 1739 | 1703 | 1667 | 1632 | 1597 | 37 |
| 38 | 1960 | 1922 | 1884 | 1847 | 1811 | 1774 | 1738 | 1702 | 1667 | 1631 | 1596 | 38 |
| 39 | 1959 | 1921 | 1884 | 1847 | 1810 | 1774 | 1737 | 1702 | 1666 | 1631 | 1596 | 39 |
| 40 | 1958 | 1921 | 1883 | 1846 | 1809 | 1773 | 1737 | 1701 | 1665 | 1630 | 1595 | 40 |
| 41 | 1958 | 1920 | 1883 | 1846 | 1809 | 1772 | 1736 | 1700 | 1665 | 1630 | 1595 | 41 |
| 42 | 1957 | 1919 | 1882 | 1845 | 1808 | 1772 | 1736 | 1700 | 1664 | 1629 | 1594 | 42 |
| 43 | 1956 | 1919 | 1881 | 1844 | 1808 | 1771 | 1735 | 1699 | 1664 | 1628 | 1593 | 43 |
| 44 | 1956 | 1918 | 1881 | 1844 | 1807 | 1771 | 1734 | 1699 | 1663 | 1628 | 1593 | 44 |
| 45 | 1955 | 1918 | 1880 | 1843 | 1806 | 1770 | 1734 | 1698 | 1663 | 1627 | 1592 | 45 |
| 46 | 1955 | 1917 | 1880 | 1843 | 1806 | 1769 | 1733 | 1697 | 1662 | 1627 | 1592 | 46 |
| 47 | 1954 | 1916 | 1879 | 1842 | 1805 | 1769 | 1733 | 1697 | 1661 | 1626 | 1591 | 47 |
| 48 | 1953 | 1916 | 1878 | 1841 | 1805 | 1768 | 1732 | 1696 | 1661 | 1626 | 1591 | 48 |
| 49 | 1953 | 1915 | 1878 | 1841 | 1804 | 1768 | 1731 | 1696 | 1660 | 1625 | 1590 | 49 |
| 50 | 1952 | 1914 | 1877 | 1840 | 1803 | 1767 | 1731 | 1695 | 1660 | 1624 | 1589 | 50 |
| 51 | 1951 | 1914 | 1876 | 1839 | 1803 | 1766 | 1730 | 1694 | 1659 | 1624 | 1589 | 51 |
| 52 | 1951 | 1913 | 1876 | 1839 | 1802 | 1766 | 1730 | 1694 | 1658 | 1623 | 1588 | 52 |
| 53 | 1950 | 1913 | 1875 | 1838 | 1802 | 1765 | 1729 | 1693 | 1658 | 1623 | 1588 | 53 |
| 54 | 1950 | 1912 | 1875 | 1838 | 1801 | 1765 | 1728 | 1693 | 1657 | 1622 | 1587 | 54 |
| 55 | 1949 | 1911 | 1874 | 1837 | 1800 | 1764 | 1728 | 1692 | 1657 | 1621 | 1587 | 55 |
| 56 | 1948 | 1911 | 1873 | 1836 | 1800 | 1763 | 1727 | 1692 | 1656 | 1621 | 1586 | 56 |
| 57 | 1948 | 1910 | 1873 | 1836 | 1799 | 1763 | 1727 | 1691 | 1655 | 1620 | 1585 | 57 |
| 58 | 1947 | 1909 | 1872 | 1835 | 1798 | 1762 | 1726 | 1690 | 1655 | 1620 | 1585 | 58 |
| 59 | 1946 | 1909 | 1871 | 1835 | 1798 | 1762 | 1725 | 1690 | 1654 | 1619 | 1584 | 59 |
| 60 | 1946 | 1908 | 1871 | 1834 | 1797 | 1761 | 1725 | 1689 | 1654 | 1619 | 1584 | 60 |

# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. " | h. m. 2° 5′ | h. m. 2° 6′ | h. m. 2° 7′ | h. m. 2° 8′ | h. m. 2° 9′ | h. m. 2° 10′ | h. m. 2° 11′ | h. m. 2° 12′ | h. m. 2° 13′ | h. m. 2° 14′ | h. m. 2° 15′ | s. " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1584 | 1549 | 1515 | 1481 | 1447 | 1413 | 1380 | 1347 | 1314 | 1282 | 1249 | 0 |
| 1 | 1583 | 1548 | 1514 | 1480 | 1446 | 1413 | 1379 | 1346 | 1314 | 1281 | 1249 | 1 |
| 2 | 1582 | 1548 | 1514 | 1479 | 1446 | 1412 | 1379 | 1346 | 1313 | 1281 | 1248 | 2 |
| 3 | 1582 | 1547 | 1513 | 1479 | 1445 | 1412 | 1378 | 1345 | 1313 | 1280 | 1248 | 3 |
| 4 | 1581 | 1547 | 1512 | 1478 | 1445 | 1411 | 1378 | 1345 | 1312 | 1280 | 1247 | 4 |
| 5 | 1581 | 1546 | 1512 | 1478 | 1444 | 1411 | 1377 | 1344 | 1311 | 1279 | 1247 | 5 |
| 6 | 1580 | 1546 | 1511 | 1477 | 1443 | 1410 | 1377 | 1344 | 1311 | 1278 | 1246 | 6 |
| 7 | 1580 | 1545 | 1511 | 1477 | 1443 | 1409 | 1376 | 1343 | 1310 | 1278 | 1246 | 7 |
| 8 | 1579 | 1544 | 1510 | 1476 | 1442 | 1409 | 1376 | 1343 | 1310 | 1277 | 1245 | 8 |
| 9 | 1578 | 1544 | 1510 | 1476 | 1442 | 1408 | 1375 | 1342 | 1309 | 1277 | 1245 | 9 |
| 10 | 1578 | 1543 | 1509 | 1475 | 1441 | 1408 | 1374 | 1342 | 1309 | 1276 | 1244 | 10 |
| 11 | 1577 | 1543 | 1508 | 1474 | 1441 | 1407 | 1374 | 1341 | 1308 | 1276 | 1243 | 11 |
| 12 | 1577 | 1542 | 1508 | 1474 | 1440 | 1407 | 1373 | 1340 | 1308 | 1275 | 1243 | 12 |
| 13 | 1576 | 1542 | 1507 | 1473 | 1440 | 1406 | 1373 | 1340 | 1307 | 1275 | 1242 | 13 |
| 14 | 1576 | 1541 | 1507 | 1473 | 1439 | 1406 | 1372 | 1339 | 1307 | 1274 | 1242 | 14 |
| 15 | 1575 | 1540 | 1506 | 1472 | 1438 | 1405 | 1372 | 1339 | 1306 | 1274 | 1241 | 15 |
| 16 | 1574 | 1540 | 1506 | 1472 | 1438 | 1404 | 1371 | 1338 | 1306 | 1273 | 1241 | 16 |
| 17 | 1574 | 1539 | 1505 | 1471 | 1437 | 1404 | 1371 | 1338 | 1305 | 1273 | 1240 | 17 |
| 18 | 1573 | 1539 | 1504 | 1470 | 1437 | 1403 | 1370 | 1337 | 1304 | 1272 | 1240 | 18 |
| 19 | 1573 | 1538 | 1504 | 1470 | 1436 | 1403 | 1370 | 1337 | 1304 | 1271 | 1239 | 19 |
| 20 | 1572 | 1538 | 1503 | 1469 | 1436 | 1402 | 1369 | 1336 | 1303 | 1271 | 1239 | 20 |
| 21 | 1571 | 1537 | 1503 | 1469 | 1435 | 1402 | 1368 | 1335 | 1303 | 1270 | 1238 | 21 |
| 22 | 1571 | 1536 | 1502 | 1468 | 1435 | 1401 | 1368 | 1335 | 1302 | 1270 | 1238 | 22 |
| 23 | 1570 | 1536 | 1502 | 1468 | 1434 | 1401 | 1367 | 1334 | 1302 | 1269 | 1237 | 23 |
| 24 | 1570 | 1535 | 1501 | 1467 | 1433 | 1400 | 1367 | 1334 | 1301 | 1269 | 1237 | 24 |
| 25 | 1569 | 1535 | 1500 | 1467 | 1433 | 1399 | 1366 | 1333 | 1301 | 1268 | 1236 | 25 |
| 26 | 1569 | 1534 | 1500 | 1466 | 1432 | 1399 | 1366 | 1333 | 1300 | 1268 | 1235 | 26 |
| 27 | 1568 | 1534 | 1499 | 1465 | 1432 | 1398 | 1365 | 1332 | 1300 | 1267 | 1235 | 27 |
| 28 | 1567 | 1533 | 1499 | 1465 | 1431 | 1398 | 1365 | 1332 | 1299 | 1267 | 1234 | 28 |
| 29 | 1567 | 1532 | 1498 | 1464 | 1431 | 1397 | 1364 | 1331 | 1298 | 1266 | 1234 | 29 |
| 30 | 1566 | 1532 | 1498 | 1464 | 1430 | 1397 | 1363 | 1331 | 1298 | 1266 | 1233 | 30 |
| 31 | 1566 | 1531 | 1497 | 1463 | 1429 | 1396 | 1363 | 1330 | 1297 | 1265 | 1233 | 31 |
| 32 | 1565 | 1531 | 1496 | 1463 | 1429 | 1396 | 1362 | 1329 | 1297 | 1264 | 1232 | 32 |
| 33 | 1565 | 1530 | 1496 | 1462 | 1428 | 1395 | 1362 | 1329 | 1296 | 1264 | 1232 | 33 |
| 34 | 1564 | 1530 | 1495 | 1461 | 1428 | 1394 | 1361 | 1328 | 1296 | 1263 | 1231 | 34 |
| 35 | 1563 | 1529 | 1495 | 1461 | 1427 | 1394 | 1361 | 1328 | 1295 | 1263 | 1231 | 35 |
| 36 | 1563 | 1528 | 1494 | 1460 | 1427 | 1393 | 1360 | 1327 | 1295 | 1262 | 1230 | 36 |
| 37 | 1562 | 1528 | 1494 | 1460 | 1426 | 1393 | 1360 | 1327 | 1294 | 1262 | 1230 | 37 |
| 38 | 1562 | 1527 | 1493 | 1459 | 1426 | 1392 | 1359 | 1326 | 1294 | 1261 | 1229 | 38 |
| 39 | 1561 | 1527 | 1493 | 1459 | 1425 | 1392 | 1359 | 1326 | 1293 | 1261 | 1229 | 39 |
| 40 | 1561 | 1526 | 1492 | 1458 | 1424 | 1391 | 1358 | 1325 | 1292 | 1260 | 1228 | 40 |
| 41 | 1560 | 1526 | 1491 | 1458 | 1424 | 1391 | 1357 | 1325 | 1292 | 1260 | 1227 | 41 |
| 42 | 1559 | 1525 | 1491 | 1457 | 1423 | 1390 | 1357 | 1324 | 1291 | 1259 | 1227 | 42 |
| 43 | 1559 | 1524 | 1490 | 1456 | 1423 | 1389 | 1356 | 1323 | 1291 | 1259 | 1226 | 43 |
| 44 | 1558 | 1524 | 1490 | 1456 | 1422 | 1389 | 1356 | 1323 | 1290 | 1258 | 1226 | 44 |
| 45 | 1558 | 1523 | 1489 | 1455 | 1422 | 1388 | 1355 | 1322 | 1290 | 1257 | 1225 | 45 |
| 46 | 1557 | 1523 | 1489 | 1455 | 1421 | 1388 | 1355 | 1322 | 1289 | 1257 | 1225 | 46 |
| 47 | 1556 | 1522 | 1488 | 1454 | 1421 | 1387 | 1354 | 1321 | 1289 | 1256 | 1224 | 47 |
| 48 | 1556 | 1522 | 1487 | 1454 | 1420 | 1387 | 1354 | 1321 | 1288 | 1256 | 1224 | 48 |
| 49 | 1555 | 1521 | 1487 | 1453 | 1419 | 1386 | 1353 | 1320 | 1288 | 1255 | 1223 | 49 |
| 50 | 1555 | 1520 | 1486 | 1452 | 1419 | 1386 | 1352 | 1320 | 1287 | 1255 | 1223 | 50 |
| 51 | 1554 | 1520 | 1486 | 1452 | 1418 | 1385 | 1352 | 1319 | 1287 | 1254 | 1222 | 51 |
| 52 | 1554 | 1519 | 1485 | 1451 | 1418 | 1384 | 1351 | 1319 | 1286 | 1254 | 1222 | 52 |
| 53 | 1553 | 1519 | 1485 | 1451 | 1417 | 1384 | 1351 | 1318 | 1285 | 1253 | 1221 | 53 |
| 54 | 1552 | 1518 | 1484 | 1450 | 1417 | 1383 | 1350 | 1317 | 1285 | 1253 | 1221 | 54 |
| 55 | 1552 | 1518 | 1483 | 1450 | 1416 | 1383 | 1350 | 1317 | 1284 | 1252 | 1220 | 55 |
| 56 | 1551 | 1517 | 1483 | 1449 | 1416 | 1382 | 1349 | 1316 | 1284 | 1252 | 1219 | 56 |
| 57 | 1551 | 1516 | 1482 | 1449 | 1415 | 1382 | 1349 | 1316 | 1283 | 1251 | 1219 | 57 |
| 58 | 1550 | 1516 | 1482 | 1448 | 1414 | 1381 | 1348 | 1315 | 1283 | 1250 | 1218 | 58 |
| 59 | 1550 | 1515 | 1481 | 1447 | 1414 | 1381 | 1348 | 1315 | 1282 | 1250 | 1218 | 59 |
| 60 | 1549 | 1515 | 1481 | 1447 | 1413 | 1380 | 1347 | 1314 | 1282 | 1249 | 1217 | 60 |

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## PROPORTIONAL LOGARITHMS.

| s. | h. m. 2° 16′ | h. m. 2° 17′ | h. m. 2° 18′ | h. m. 2° 19′ | h. m. 2° 20′ | h. m. 2° 21′ | h. m. 2° 22′ | h. m. 2° 23′ | h. m. 2° 24′ | h. m. 2° 25′ | h. m. 2° 26′ | s. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1217 | 1186 | 1154 | 1123 | 1091 | 1061 | 1030 | 0999 | 0969 | 0939 | 0909 | 0 |
| 1 | 1217 | 1185 | 1153 | 1122 | 1091 | 1060 | 1029 | 0999 | 0969 | 0939 | 0909 | 1 |
| 2 | 1216 | 1184 | 1153 | 1122 | 1090 | 1060 | 1029 | 0998 | 0968 | 0938 | 0908 | 2 |
| 3 | 1216 | 1184 | 1152 | 1121 | 1090 | 1059 | 1028 | 0998 | 0968 | 0938 | 0908 | 3 |
| 4 | 1215 | 1183 | 1152 | 1120 | 1089 | 1058 | 1028 | 0997 | 0967 | 0937 | 0907 | 4 |
| 5 | 1215 | 1183 | 1151 | 1120 | 1089 | 1058 | 1027 | 0997 | 0967 | 0937 | 0907 | 5 |
| 6 | 1214 | 1182 | 1151 | 1119 | 1088 | 1057 | 1027 | 0996 | 0966 | 0936 | 0906 | 6 |
| 7 | 1214 | 1182 | 1150 | 1119 | 1088 | 1057 | 1026 | 0996 | 0966 | 0936 | 0906 | 7 |
| 8 | 1213 | 1181 | 1150 | 1118 | 1087 | 1056 | 1026 | 0995 | 0965 | 0935 | 0905 | 8 |
| 9 | 1213 | 1181 | 1149 | 1118 | 1087 | 1056 | 1025 | 0995 | 0965 | 0935 | 0905 | 9 |
| 10 | 1212 | 1180 | 1149 | 1117 | 1086 | 1055 | 1025 | 0994 | 0964 | 0934 | 0904 | 10 |
| 11 | 1211 | 1180 | 1148 | 1117 | 1086 | 1055 | 1024 | 0994 | 0964 | 0934 | 0904 | 11 |
| 12 | 1211 | 1179 | 1148 | 1116 | 1085 | 1054 | 1024 | 0993 | 0963 | 0933 | 0903 | 12 |
| 13 | 1210 | 1179 | 1147 | 1116 | 1085 | 1054 | 1023 | 0993 | 0963 | 0933 | 0903 | 13 |
| 14 | 1210 | 1178 | 1147 | 1115 | 1084 | 1053 | 1023 | 0992 | 0962 | 0932 | 0902 | 14 |
| 15 | 1209 | 1178 | 1146 | 1115 | 1084 | 1053 | 1022 | 0992 | 0962 | 0932 | 0902 | 15 |
| 16 | 1209 | 1177 | 1146 | 1114 | 1083 | 1052 | 1022 | 0991 | 0961 | 0931 | 0901 | 16 |
| 17 | 1208 | 1177 | 1145 | 1114 | 1083 | 1052 | 1021 | 0991 | 0961 | 0931 | 0901 | 17 |
| 18 | 1208 | 1176 | 1145 | 1113 | 1082 | 1051 | 1021 | 0990 | 0960 | 0930 | 0900 | 18 |
| 19 | 1207 | 1175 | 1144 | 1113 | 1082 | 1051 | 1020 | 0990 | 0960 | 0930 | 0900 | 19 |
| 20 | 1207 | 1175 | 1143 | 1112 | 1081 | 1050 | 1020 | 0989 | 0959 | 0929 | 0899 | 20 |
| 21 | 1206 | 1174 | 1143 | 1112 | 1081 | 1050 | 1019 | 0989 | 0959 | 0929 | 0899 | 21 |
| 22 | 1206 | 1174 | 1142 | 1111 | 1080 | 1049 | 1019 | 0988 | 0958 | 0928 | 0898 | 22 |
| 23 | 1205 | 1173 | 1142 | 1111 | 1080 | 1049 | 1018 | 0988 | 0958 | 0928 | 0898 | 23 |
| 24 | 1205 | 1173 | 1141 | 1110 | 1079 | 1048 | 1018 | 0987 | 0957 | 0927 | 0897 | 24 |
| 25 | 1204 | 1172 | 1141 | 1110 | 1079 | 1048 | 1017 | 0987 | 0957 | 0927 | 0897 | 25 |
| 26 | 1204 | 1172 | 1140 | 1109 | 1078 | 1047 | 1017 | 0986 | 0956 | 0926 | 0896 | 26 |
| 27 | 1203 | 1171 | 1140 | 1109 | 1078 | 1047 | 1016 | 0986 | 0956 | 0926 | 0896 | 27 |
| 28 | 1202 | 1171 | 1139 | 1108 | 1077 | 1046 | 1016 | 0985 | 0955 | 0925 | 0895 | 28 |
| 29 | 1202 | 1170 | 1139 | 1108 | 1076 | 1046 | 1015 | 0985 | 0955 | 0925 | 0895 | 29 |
| 30 | 1201 | 1170 | 1138 | 1107 | 1076 | 1045 | 1015 | 0984 | 0954 | 0924 | 0894 | 30 |
| 31 | 1201 | 1169 | 1138 | 1106 | 1075 | 1045 | 1014 | 0984 | 0954 | 0924 | 0894 | 31 |
| 32 | 1200 | 1169 | 1137 | 1106 | 1075 | 1044 | 1014 | 0983 | 0953 | 0923 | 0893 | 32 |
| 33 | 1200 | 1168 | 1137 | 1105 | 1074 | 1044 | 1013 | 0983 | 0953 | 0923 | 0893 | 33 |
| 34 | 1199 | 1168 | 1136 | 1105 | 1074 | 1043 | 1013 | 0982 | 0952 | 0922 | 0892 | 34 |
| 35 | 1199 | 1167 | 1136 | 1104 | 1073 | 1043 | 1012 | 0982 | 0952 | 0922 | 0892 | 35 |
| 36 | 1198 | 1167 | 1135 | 1104 | 1073 | 1042 | 1012 | 0981 | 0951 | 0921 | 0891 | 36 |
| 37 | 1198 | 1166 | 1135 | 1103 | 1072 | 1042 | 1011 | 0981 | 0951 | 0921 | 0891 | 37 |
| 38 | 1197 | 1165 | 1134 | 1103 | 1072 | 1041 | 1011 | 0980 | 0950 | 0920 | 0890 | 38 |
| 39 | 1197 | 1165 | 1134 | 1102 | 1071 | 1041 | 1010 | 0980 | 0950 | 0920 | 0890 | 39 |
| 40 | 1196 | 1164 | 1133 | 1102 | 1071 | 1040 | 1009 | 0979 | 0949 | 0919 | 0889 | 40 |
| 41 | 1196 | 1164 | 1132 | 1101 | 1070 | 1040 | 1009 | 0979 | 0949 | 0919 | 0889 | 41 |
| 42 | 1195 | 1163 | 1132 | 1101 | 1070 | 1039 | 1008 | 0978 | 0948 | 0918 | 0888 | 42 |
| 43 | 1195 | 1163 | 1131 | 1100 | 1069 | 1039 | 1008 | 0978 | 0948 | 0918 | 0888 | 43 |
| 44 | 1194 | 1162 | 1131 | 1100 | 1069 | 1038 | 1007 | 0977 | 0947 | 0917 | 0887 | 44 |
| 45 | 1193 | 1162 | 1130 | 1099 | 1068 | 1037 | 1007 | 0977 | 0947 | 0917 | 0887 | 45 |
| 46 | 1193 | 1161 | 1130 | 1099 | 1068 | 1037 | 1006 | 0976 | 0946 | 0916 | 0886 | 46 |
| 47 | 1192 | 1161 | 1129 | 1098 | 1067 | 1036 | 1006 | 0976 | 0946 | 0916 | 0886 | 47 |
| 48 | 1192 | 1160 | 1129 | 1098 | 1067 | 1036 | 1005 | 0975 | 0945 | 0915 | 0885 | 48 |
| 49 | 1191 | 1160 | 1128 | 1097 | 1066 | 1035 | 1005 | 0975 | 0945 | 0915 | 0885 | 49 |
| 50 | 1191 | 1159 | 1128 | 1097 | 1066 | 1035 | 1004 | 0974 | 0944 | 0914 | 0884 | 50 |
| 51 | 1190 | 1159 | 1127 | 1096 | 1065 | 1034 | 1004 | 0974 | 0944 | 0914 | 0884 | 51 |
| 52 | 1190 | 1158 | 1127 | 1096 | 1065 | 1034 | 1003 | 0973 | 0943 | 0913 | 0883 | 52 |
| 53 | 1189 | 1158 | 1126 | 1095 | 1064 | 1033 | 1003 | 0973 | 0943 | 0913 | 0883 | 53 |
| 54 | 1189 | 1157 | 1126 | 1095 | 1064 | 1033 | 1002 | 0972 | 0942 | 0912 | 0883 | 54 |
| 55 | 1188 | 1157 | 1125 | 1094 | 1063 | 1032 | 1002 | 0972 | 0942 | 0912 | 0882 | 55 |
| 56 | 1188 | 1156 | 1125 | 1094 | 1063 | 1032 | 1001 | 0971 | 0941 | 0911 | 0882 | 56 |
| 57 | 1187 | 1156 | 1124 | 1093 | 1062 | 1031 | 1001 | 0971 | 0941 | 0911 | 0881 | 57 |
| 58 | 1187 | 1155 | 1124 | 1092 | 1062 | 1031 | 1000 | 0970 | 0940 | 0910 | 0881 | 58 |
| 59 | 1186 | 1154 | 1123 | 1092 | 1061 | 1030 | 1000 | 0970 | 0940 | 0910 | 0880 | 59 |
| 60 | 1186 | 1154 | 1123 | 1091 | 1061 | 1030 | 0999 | 0969 | 0939 | 0909 | 0880 | 60 |

# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. | h. m. 2° 27′ | h. m. 2° 28′ | h. m. 2° 29′ | h. m. 2° 30′ | h. m. 2° 31′ | h. m. 2° 32′ | h. m. 2° 33′ | h. m. 2° 34′ | h. m. 2° 35′ | h. m. 2° 36′ | h. m. 2° 37′ | s. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0880 | 0850 | 0821 | 0792 | 0763 | 0734 | 0706 | 0678 | 0649 | 0621 | 0594 | 0 |
| 1 | 0879 | 0850 | 0820 | 0791 | 0762 | 0734 | 0705 | 0677 | 0649 | 0621 | 0593 | 1 |
| 2 | 0879 | 0849 | 0820 | 0791 | 0762 | 0733 | 0705 | 0677 | 0648 | 0621 | 0593 | 2 |
| 3 | 0878 | 0849 | 0819 | 0790 | 0762 | 0733 | 0704 | 0676 | 0648 | 0620 | 0592 | 3 |
| 4 | 0878 | 0848 | 0819 | 0790 | 0761 | 0732 | 0704 | 0676 | 0648 | 0620 | 0592 | 4 |
| 5 | 0877 | 0848 | 0818 | 0789 | 0761 | 0732 | 0703 | 0675 | 0647 | 0619 | 0591 | 5 |
| 6 | 0877 | 0847 | 0818 | 0789 | 0760 | 0731 | 0703 | 0675 | 0647 | 0619 | 0591 | 6 |
| 7 | 0876 | 0847 | 0817 | 0788 | 0760 | 0731 | 0703 | 0674 | 0646 | 0618 | 0591 | 7 |
| 8 | 0876 | 0846 | 0817 | 0788 | 0759 | 0730 | 0702 | 0674 | 0646 | 0618 | 0590 | 8 |
| 9 | 0875 | 0846 | 0816 | 0787 | 0759 | 0730 | 0702 | 0673 | 0645 | 0617 | 0590 | 9 |
| 10 | 0875 | 0845 | 0816 | 0787 | 0758 | 0730 | 0701 | 0673 | 0645 | 0617 | 0589 | 10 |
| 11 | 0874 | 0845 | 0816 | 0787 | 0758 | 0729 | 0701 | 0672 | 0644 | 0616 | 0589 | 11 |
| 12 | 0874 | 0844 | 0815 | 0786 | 0757 | 0729 | 0700 | 0672 | 0644 | 0616 | 0588 | 12 |
| 13 | 0873 | 0844 | 0815 | 0786 | 0757 | 0728 | 0700 | 0671 | 0643 | 0615 | 0588 | 13 |
| 14 | 0873 | 0843 | 0814 | 0785 | 0756 | 0728 | 0699 | 0671 | 0643 | 0615 | 0587 | 14 |
| 15 | 0872 | 0843 | 0814 | 0785 | 0756 | 0727 | 0699 | 0670 | 0642 | 0615 | 0587 | 15 |
| 16 | 0872 | 0842 | 0813 | 0784 | 0755 | 0727 | 0698 | 0670 | 0642 | 0614 | 0586 | 16 |
| 17 | 0871 | 0842 | 0813 | 0784 | 0755 | 0726 | 0698 | 0670 | 0641 | 0614 | 0586 | 17 |
| 18 | 0871 | 0841 | 0812 | 0783 | 0754 | 0726 | 0697 | 0669 | 0641 | 0613 | 0585 | 18 |
| 19 | 0870 | 0841 | 0812 | 0783 | 0754 | 0725 | 0697 | 0669 | 0641 | 0613 | 0585 | 19 |
| 20 | 0870 | 0840 | 0811 | 0782 | 0753 | 0725 | 0696 | 0668 | 0640 | 0612 | 0585 | 20 |
| 21 | 0869 | 0840 | 0811 | 0782 | 0753 | 0724 | 0696 | 0668 | 0640 | 0612 | 0584 | 21 |
| 22 | 0869 | 0839 | 0810 | 0781 | 0752 | 0724 | 0695 | 0667 | 0639 | 0611 | 0584 | 22 |
| 23 | 0868 | 0839 | 0810 | 0781 | 0752 | 0723 | 0695 | 0667 | 0639 | 0611 | 0583 | 23 |
| 24 | 0868 | 0838 | 0809 | 0780 | 0751 | 0723 | 0695 | 0666 | 0638 | 0610 | 0583 | 24 |
| 25 | 0867 | 0838 | 0809 | 0780 | 0751 | 0722 | 0694 | 0666 | 0638 | 0610 | 0582 | 25 |
| 26 | 0867 | 0837 | 0808 | 0779 | 0751 | 0722 | 0694 | 0665 | 0637 | 0609 | 0582 | 26 |
| 27 | 0866 | 0837 | 0808 | 0779 | 0750 | 0721 | 0693 | 0665 | 0637 | 0609 | 0581 | 27 |
| 28 | 0866 | 0836 | 0807 | 0778 | 0750 | 0721 | 0693 | 0664 | 0636 | 0609 | 0581 | 28 |
| 29 | 0865 | 0836 | 0807 | 0778 | 0749 | 0721 | 0692 | 0664 | 0636 | 0608 | 0580 | 29 |
| 30 | 0865 | 0835 | 0806 | 0777 | 0749 | 0720 | 0692 | 0663 | 0635 | 0608 | 0580 | 30 |
| 31 | 0864 | 0835 | 0806 | 0777 | 0748 | 0720 | 0691 | 0663 | 0635 | 0607 | 0579 | 31 |
| 32 | 0864 | 0834 | 0805 | 0776 | 0748 | 0719 | 0691 | 0663 | 0634 | 0607 | 0579 | 32 |
| 33 | 0863 | 0834 | 0805 | 0776 | 0747 | 0719 | 0690 | 0662 | 0634 | 0606 | 0579 | 33 |
| 34 | 0863 | 0834 | 0804 | 0775 | 0747 | 0718 | 0690 | 0662 | 0634 | 0606 | 0578 | 34 |
| 35 | 0862 | 0833 | 0804 | 0775 | 0746 | 0718 | 0689 | 0661 | 0633 | 0605 | 0578 | 35 |
| 36 | 0862 | 0833 | 0803 | 0774 | 0746 | 0717 | 0689 | 0661 | 0633 | 0605 | 0577 | 36 |
| 37 | 0861 | 0832 | 0803 | 0774 | 0745 | 0717 | 0688 | 0660 | 0632 | 0604 | 0577 | 37 |
| 38 | 0861 | 0832 | 0802 | 0774 | 0745 | 0716 | 0688 | 0660 | 0632 | 0604 | 0576 | 38 |
| 39 | 0860 | 0831 | 0802 | 0773 | 0744 | 0716 | 0687 | 0659 | 0631 | 0603 | 0576 | 39 |
| 40 | 0860 | 0831 | 0801 | 0773 | 0744 | 0715 | 0687 | 0659 | 0631 | 0603 | 0575 | 40 |
| 41 | 0859 | 0830 | 0801 | 0772 | 0743 | 0715 | 0686 | 0658 | 0630 | 0602 | 0575 | 41 |
| 42 | 0859 | 0830 | 0801 | 0772 | 0743 | 0714 | 0686 | 0658 | 0630 | 0602 | 0574 | 42 |
| 43 | 0858 | 0829 | 0800 | 0771 | 0742 | 0714 | 0686 | 0657 | 0629 | 0602 | 0574 | 43 |
| 44 | 0858 | 0829 | 0800 | 0771 | 0742 | 0713 | 0685 | 0657 | 0629 | 0601 | 0573 | 44 |
| 45 | 0857 | 0828 | 0799 | 0770 | 0741 | 0713 | 0685 | 0656 | 0628 | 0601 | 0573 | 45 |
| 46 | 0857 | 0828 | 0799 | 0770 | 0741 | 0712 | 0684 | 0656 | 0628 | 0600 | 0573 | 46 |
| 47 | 0856 | 0827 | 0798 | 0769 | 0740 | 0712 | 0684 | 0655 | 0628 | 0600 | 0572 | 47 |
| 48 | 0856 | 0827 | 0798 | 0769 | 0740 | 0711 | 0683 | 0655 | 0627 | 0599 | 0572 | 48 |
| 49 | 0855 | 0826 | 0797 | 0768 | 0740 | 0711 | 0683 | 0655 | 0627 | 0599 | 0571 | 49 |
| 50 | 0855 | 0826 | 0797 | 0768 | 0739 | 0711 | 0682 | 0654 | 0626 | 0598 | 0571 | 50 |
| 51 | 0855 | 0825 | 0796 | 0767 | 0739 | 0710 | 0682 | 0654 | 0626 | 0598 | 0570 | 51 |
| 52 | 0854 | 0825 | 0796 | 0767 | 0738 | 0710 | 0681 | 0653 | 0625 | 0597 | 0570 | 52 |
| 53 | 0854 | 0824 | 0795 | 0766 | 0738 | 0709 | 0681 | 0653 | 0625 | 0597 | 0569 | 53 |
| 54 | 0853 | 0824 | 0795 | 0766 | 0737 | 0709 | 0680 | 0652 | 0624 | 0596 | 0569 | 54 |
| 55 | 0853 | 0823 | 0794 | 0765 | 0737 | 0708 | 0680 | 0652 | 0624 | 0596 | 0568 | 55 |
| 56 | 0852 | 0823 | 0794 | 0765 | 0736 | 0708 | 0679 | 0651 | 0623 | 0596 | 0568 | 56 |
| 57 | 0852 | 0822 | 0793 | 0764 | 0736 | 0707 | 0679 | 0651 | 0623 | 0595 | 0568 | 57 |
| 58 | 0851 | 0822 | 0793 | 0764 | 0735 | 0707 | 0678 | 0650 | 0622 | 0595 | 0567 | 58 |
| 59 | 0851 | 0821 | 0792 | 0763 | 0735 | 0706 | 0678 | 0650 | 0622 | 0594 | 0567 | 59 |
| 60 | 0850 | 0821 | 0792 | 0763 | 0734 | 0706 | 0678 | 0649 | 0621 | 0594 | 0566 | 60 |

## PROPORTIONAL LOGARITHMS.

| s. | h. m. 2° 38′ | h. m. 2° 39′ | h. m. 2° 40′ | h. m. 2° 41′ | h. m. 2° 42′ | h. m. 2° 43′ | h. m. 2° 44′ | h. m. 2° 45′ | h. m. 2° 46′ | h. m. 2° 47′ | h. m. 2° 48′ | s. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0566 | 0539 | 0512 | 0484 | 0458 | 0431 | 0404 | 0378 | 0352 | 0326 | 0300 | 0 |
| 1 | 0566 | 0538 | 0511 | 0484 | 0457 | 0430 | 0404 | 0377 | 0351 | 0325 | 0299 | 1 |
| 2 | 0565 | 0538 | 0511 | 0484 | 0457 | 0430 | 0403 | 0377 | 0351 | 0325 | 0299 | 2 |
| 3 | 0565 | 0537 | 0510 | 0483 | 0456 | 0430 | 0403 | 0377 | 0350 | 0324 | 0298 | 3 |
| 4 | 0564 | 0537 | 0510 | 0483 | 0456 | 0429 | 0403 | 0376 | 0350 | 0324 | 0298 | 4 |
| 5 | 0564 | 0536 | 0509 | 0482 | 0455 | 0429 | 0402 | 0376 | 0349 | 0323 | 0297 | 5 |
| 6 | 0563 | 0536 | 0509 | 0482 | 0455 | 0428 | 0402 | 0375 | 0349 | 0323 | 0297 | 6 |
| 7 | 0563 | 0536 | 0508 | 0481 | 0454 | 0428 | 0401 | 0375 | 0349 | 0323 | 0297 | 7 |
| 8 | 0562 | 0535 | 0508 | 0481 | 0454 | 0427 | 0401 | 0374 | 0348 | 0322 | 0296 | 8 |
| 9 | 0562 | 0535 | 0507 | 0480 | 0454 | 0427 | 0400 | 0374 | 0348 | 0322 | 0296 | 9 |
| 10 | 0562 | 0534 | 0507 | 0480 | 0453 | 0426 | 0400 | 0374 | 0347 | 0321 | 0295 | 10 |
| 11 | 0561 | 0534 | 0507 | 0480 | 0453 | 0426 | 0399 | 0373 | 0347 | 0321 | 0295 | 11 |
| 12 | 0561 | 0533 | 0506 | 0479 | 0452 | 0426 | 0399 | 0373 | 0346 | 0320 | 0294 | 12 |
| 13 | 0560 | 0533 | 0506 | 0479 | 0452 | 0425 | 0399 | 0372 | 0346 | 0320 | 0294 | 13 |
| 14 | 0560 | 0532 | 0505 | 0478 | 0451 | 0425 | 0398 | 0372 | 0346 | 0319 | 0294 | 14 |
| 15 | 0559 | 0532 | 0505 | 0478 | 0451 | 0424 | 0398 | 0371 | 0345 | 0319 | 0293 | 15 |
| 16 | 0559 | 0531 | 0504 | 0477 | 0450 | 0424 | 0397 | 0371 | 0345 | 0319 | 0293 | 16 |
| 17 | 0558 | 0531 | 0504 | 0477 | 0450 | 0423 | 0397 | 0370 | 0344 | 0318 | 0292 | 17 |
| 18 | 0558 | 0531 | 0503 | 0476 | 0450 | 0423 | 0396 | 0370 | 0344 | 0318 | 0292 | 18 |
| 19 | 0557 | 0530 | 0503 | 0476 | 0449 | 0422 | 0396 | 0370 | 0343 | 0317 | 0291 | 19 |
| 20 | 0557 | 0530 | 0502 | 0475 | 0449 | 0422 | 0395 | 0369 | 0343 | 0317 | 0291 | 20 |
| 21 | 0557 | 0529 | 0502 | 0475 | 0448 | 0422 | 0395 | 0369 | 0342 | 0316 | 0291 | 21 |
| 22 | 0556 | 0529 | 0502 | 0475 | 0448 | 0421 | 0395 | 0368 | 0342 | 0316 | 0290 | 22 |
| 23 | 0556 | 0528 | 0501 | 0474 | 0447 | 0421 | 0394 | 0368 | 0342 | 0316 | 0290 | 23 |
| 24 | 0555 | 0528 | 0501 | 0474 | 0447 | 0420 | 0394 | 0367 | 0341 | 0315 | 0289 | 24 |
| 25 | 0555 | 0527 | 0500 | 0473 | 0446 | 0420 | 0393 | 0367 | 0341 | 0315 | 0289 | 25 |
| 26 | 0554 | 0527 | 0500 | 0473 | 0446 | 0419 | 0393 | 0366 | 0340 | 0314 | 0288 | 26 |
| 27 | 0554 | 0526 | 0499 | 0472 | 0446 | 0419 | 0392 | 0366 | 0340 | 0314 | 0288 | 27 |
| 28 | 0553 | 0526 | 0499 | 0472 | 0445 | 0418 | 0392 | 0366 | 0339 | 0313 | 0288 | 28 |
| 29 | 0553 | 0526 | 0498 | 0471 | 0445 | 0418 | 0391 | 0365 | 0339 | 0313 | 0287 | 29 |
| 30 | 0552 | 0525 | 0498 | 0471 | 0444 | 0418 | 0391 | 0365 | 0339 | 0313 | 0287 | 30 |
| 31 | 0552 | 0525 | 0498 | 0471 | 0444 | 0417 | 0391 | 0364 | 0338 | 0312 | 0286 | 31 |
| 32 | 0552 | 0524 | 0497 | 0470 | 0443 | 0417 | 0390 | 0364 | 0338 | 0312 | 0286 | 32 |
| 33 | 0551 | 0524 | 0497 | 0470 | 0443 | 0416 | 0390 | 0363 | 0337 | 0311 | 0285 | 33 |
| 34 | 0551 | 0523 | 0496 | 0469 | 0442 | 0416 | 0389 | 0363 | 0337 | 0311 | 0285 | 34 |
| 35 | 0550 | 0523 | 0496 | 0469 | 0442 | 0415 | 0389 | 0363 | 0336 | 0310 | 0285 | 35 |
| 36 | 0550 | 0522 | 0495 | 0468 | 0442 | 0415 | 0388 | 0362 | 0336 | 0310 | 0284 | 36 |
| 37 | 0549 | 0522 | 0495 | 0468 | 0441 | 0414 | 0388 | 0362 | 0336 | 0310 | 0284 | 37 |
| 38 | 0549 | 0521 | 0494 | 0467 | 0441 | 0414 | 0388 | 0361 | 0335 | 0309 | 0283 | 38 |
| 39 | 0548 | 0521 | 0494 | 0467 | 0440 | 0414 | 0387 | 0361 | 0335 | 0309 | 0283 | 39 |
| 40 | 0548 | 0521 | 0493 | 0467 | 0440 | 0413 | 0387 | 0360 | 0334 | 0308 | 0282 | 40 |
| 41 | 0547 | 0520 | 0493 | 0466 | 0439 | 0413 | 0386 | 0360 | 0334 | 0308 | 0282 | 41 |
| 42 | 0547 | 0520 | 0493 | 0466 | 0439 | 0412 | 0386 | 0359 | 0333 | 0307 | 0282 | 42 |
| 43 | 0546 | 0519 | 0492 | 0465 | 0438 | 0412 | 0385 | 0359 | 0333 | 0307 | 0281 | 43 |
| 44 | 0546 | 0519 | 0492 | 0465 | 0438 | 0411 | 0385 | 0359 | 0333 | 0307 | 0281 | 44 |
| 45 | 0546 | 0518 | 0491 | 0464 | 0438 | 0411 | 0384 | 0358 | 0332 | 0306 | 0280 | 45 |
| 46 | 0545 | 0518 | 0491 | 0464 | 0437 | 0410 | 0384 | 0358 | 0332 | 0306 | 0280 | 46 |
| 47 | 0545 | 0517 | 0490 | 0463 | 0437 | 0410 | 0384 | 0357 | 0331 | 0305 | 0279 | 47 |
| 48 | 0544 | 0517 | 0490 | 0463 | 0436 | 0410 | 0383 | 0357 | 0331 | 0305 | 0279 | 48 |
| 49 | 0544 | 0517 | 0489 | 0462 | 0436 | 0409 | 0383 | 0356 | 0330 | 0304 | 0279 | 49 |
| 50 | 0543 | 0516 | 0489 | 0462 | 0435 | 0409 | 0382 | 0356 | 0330 | 0304 | 0278 | 50 |
| 51 | 0543 | 0516 | 0489 | 0462 | 0435 | 0408 | 0382 | 0356 | 0329 | 0304 | 0278 | 51 |
| 52 | 0542 | 0515 | 0488 | 0461 | 0434 | 0408 | 0381 | 0355 | 0329 | 0303 | 0277 | 52 |
| 53 | 0542 | 0515 | 0488 | 0461 | 0434 | 0407 | 0381 | 0355 | 0329 | 0303 | 0277 | 53 |
| 54 | 0541 | 0514 | 0487 | 0460 | 0434 | 0407 | 0381 | 0354 | 0328 | 0302 | 0276 | 54 |
| 55 | 0541 | 0514 | 0487 | 0460 | 0433 | 0406 | 0380 | 0354 | 0328 | 0302 | 0276 | 55 |
| 56 | 0541 | 0513 | 0486 | 0459 | 0433 | 0406 | 0380 | 0353 | 0327 | 0301 | 0276 | 56 |
| 57 | 0540 | 0513 | 0486 | 0459 | 0432 | 0406 | 0379 | 0353 | 0327 | 0301 | 0275 | 57 |
| 58 | 0540 | 0512 | 0485 | 0458 | 0432 | 0405 | 0379 | 0353 | 0326 | 0300 | 0275 | 58 |
| 59 | 0539 | 0512 | 0485 | 0458 | 0431 | 0405 | 0378 | 0352 | 0326 | 0300 | 0274 | 59 |
| 60 | 0539 | 0512 | 0484 | 0458 | 0431 | 0404 | 0378 | 0352 | 0326 | 0300 | 0274 | 60 |

# TABLE XXXIV.

## PROPORTIONAL LOGARITHMS.

| s. ″ | h. m. 2° 49′ | h. m. 2° 50′ | h. m. 2° 51′ | h. m. 2° 52′ | h. m. 2° 53′ | h. m. 2° 54′ | h. m. 2° 55′ | h. m. 2° 56′ | h. m. 2° 57′ | h. m. 2° 58′ | h. m. 2° 59′ | s. ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0274 | 0248 | 0223 | 0197 | 0172 | 0147 | 0122 | 0098 | 0073 | 0049 | 0024 | 0 |
| 1 | 0273 | 0248 | 0222 | 0197 | 0172 | 0147 | 0122 | 0097 | 0073 | 0048 | 0024 | 1 |
| 2 | 0273 | 0247 | 0222 | 0197 | 0171 | 0146 | 0122 | 0097 | 0072 | 0048 | 0023 | 2 |
| 3 | 0273 | 0247 | 0221 | 0196 | 0171 | 0146 | 0121 | 0096 | 0072 | 0047 | 0023 | 3 |
| 4 | 0272 | 0247 | 0221 | 0196 | 0171 | 0146 | 0121 | 0096 | 0071 | 0047 | 0023 | 4 |
| 5 | 0272 | 0246 | 0221 | 0195 | 0170 | 0145 | 0120 | 0096 | 0071 | 0046 | 0022 | 5 |
| 6 | 0271 | 0246 | 0220 | 0195 | 0170 | 0145 | 0120 | 0095 | 0071 | 0046 | 0022 | 6 |
| 7 | 0271 | 0245 | 0220 | 0194 | 0169 | 0144 | 0119 | 0095 | 0070 | 0046 | 0021 | 7 |
| 8 | 0270 | 0245 | 0219 | 0194 | 0169 | 0144 | 0119 | 0094 | 0070 | 0045 | 0021 | 8 |
| 9 | 0270 | 0244 | 0219 | 0194 | 0169 | 0143 | 0119 | 0094 | 0069 | 0045 | 0021 | 9 |
| 10 | 0270 | 0244 | 0219 | 0193 | 0168 | 0143 | 0118 | 0093 | 0069 | 0044 | 0020 | 10 |
| 11 | 0269 | 0244 | 0218 | 0193 | 0168 | 0143 | 0118 | 0093 | 0068 | 0044 | 0020 | 11 |
| 12 | 0269 | 0243 | 0218 | 0192 | 0167 | 0142 | 0117 | 0093 | 0068 | 0044 | 0019 | 12 |
| 13 | 0268 | 0243 | 0217 | 0192 | 0167 | 0142 | 0117 | 0092 | 0068 | 0043 | 0019 | 13 |
| 14 | 0268 | 0242 | 0217 | 0192 | 0166 | 0141 | 0117 | 0092 | 0067 | 0043 | 0019 | 14 |
| 15 | 0267 | 0242 | 0216 | 0191 | 0166 | 0141 | 0116 | 0091 | 0067 | 0042 | 0018 | 15 |
| 16 | 0267 | 0241 | 0216 | 0191 | 0166 | 0141 | 0116 | 0091 | 0066 | 0042 | 0018 | 16 |
| 17 | 0267 | 0241 | 0216 | 0190 | 0165 | 0140 | 0115 | 0091 | 0066 | 0042 | 0017 | 17 |
| 18 | 0266 | 0241 | 0215 | 0190 | 0165 | 0140 | 0115 | 0090 | 0066 | 0041 | 0017 | 18 |
| 19 | 0266 | 0240 | 0215 | 0189 | 0164 | 0139 | 0114 | 0090 | 0065 | 0041 | 0017 | 19 |
| 20 | 0265 | 0240 | 0214 | 0189 | 0164 | 0139 | 0114 | 0089 | 0065 | 0040 | 0016 | 20 |
| 21 | 0265 | 0239 | 0214 | 0189 | 0163 | 0139 | 0114 | 0089 | 0064 | 0040 | 0016 | 21 |
| 22 | 0264 | 0239 | 0213 | 0188 | 0163 | 0138 | 0113 | 0089 | 0064 | 0040 | 0015 | 22 |
| 23 | 0264 | 0238 | 0213 | 0188 | 0163 | 0138 | 0113 | 0088 | 0064 | 0039 | 0015 | 23 |
| 24 | 0264 | 0238 | 0213 | 0187 | 0162 | 0137 | 0112 | 0088 | 0063 | 0039 | 0015 | 24 |
| 25 | 0263 | 0238 | 0212 | 0187 | 0162 | 0137 | 0112 | 0087 | 0063 | 0038 | 0014 | 25 |
| 26 | 0263 | 0237 | 0212 | 0187 | 0161 | 0136 | 0112 | 0087 | 0062 | 0038 | 0014 | 26 |
| 27 | 0262 | 0237 | 0211 | 0186 | 0161 | 0136 | 0111 | 0087 | 0062 | 0038 | 0013 | 27 |
| 28 | 0262 | 0236 | 0211 | 0186 | 0161 | 0136 | 0111 | 0086 | 0062 | 0037 | 0013 | 28 |
| 29 | 0261 | 0236 | 0211 | 0185 | 0160 | 0135 | 0110 | 0086 | 0061 | 0037 | 0012 | 29 |
| 30 | 0261 | 0235 | 0210 | 0185 | 0160 | 0135 | 0110 | 0085 | 0061 | 0036 | 0012 | 30 |
| 31 | 0261 | 0235 | 0210 | 0184 | 0159 | 0134 | 0110 | 0085 | 0060 | 0036 | 0012 | 31 |
| 32 | 0260 | 0235 | 0209 | 0184 | 0159 | 0134 | 0109 | 0084 | 0060 | 0036 | 0011 | 32 |
| 33 | 0260 | 0234 | 0209 | 0184 | 0158 | 0134 | 0109 | 0084 | 0060 | 0035 | 0011 | 33 |
| 34 | 0259 | 0234 | 0208 | 0183 | 0158 | 0133 | 0108 | 0084 | 0059 | 0035 | 0010 | 34 |
| 35 | 0259 | 0233 | 0208 | 0183 | 0158 | 0133 | 0108 | 0083 | 0059 | 0034 | 0010 | 35 |
| 36 | 0258 | 0233 | 0208 | 0182 | 0157 | 0132 | 0107 | 0083 | 0058 | 0034 | 0010 | 36 |
| 37 | 0258 | 0233 | 0207 | 0182 | 0157 | 0132 | 0107 | 0082 | 0058 | 0034 | 0009 | 37 |
| 38 | 0258 | 0232 | 0207 | 0181 | 0156 | 0131 | 0107 | 0082 | 0057 | 0033 | 0009 | 38 |
| 39 | 0257 | 0232 | 0206 | 0181 | 0156 | 0131 | 0106 | 0082 | 0057 | 0033 | 0008 | 39 |
| 40 | 0257 | 0231 | 0206 | 0181 | 0156 | 0131 | 0106 | 0081 | 0057 | 0032 | 0008 | 40 |
| 41 | 0256 | 0231 | 0205 | 0180 | 0155 | 0130 | 0105 | 0081 | 0056 | 0032 | 0008 | 41 |
| 42 | 0256 | 0230 | 0205 | 0180 | 0155 | 0130 | 0105 | 0080 | 0056 | 0031 | 0007 | 42 |
| 43 | 0255 | 0230 | 0205 | 0179 | 0154 | 0129 | 0105 | 0080 | 0055 | 0031 | 0007 | 43 |
| 44 | 0255 | 0230 | 0204 | 0179 | 0154 | 0129 | 0104 | 0080 | 0055 | 0031 | 0006 | 44 |
| 45 | 0255 | 0229 | 0204 | 0179 | 0153 | 0129 | 0104 | 0079 | 0055 | 0030 | 0006 | 45 |
| 46 | 0254 | 0229 | 0203 | 0178 | 0153 | 0128 | 0103 | 0079 | 0054 | 0030 | 0006 | 46 |
| 47 | 0254 | 0228 | 0203 | 0178 | 0153 | 0128 | 0103 | 0078 | 0054 | 0029 | 0005 | 47 |
| 48 | 0253 | 0228 | 0202 | 0177 | 0152 | 0127 | 0103 | 0078 | 0053 | 0029 | 0005 | 48 |
| 49 | 0253 | 0227 | 0202 | 0177 | 0152 | 0127 | 0102 | 0077 | 0053 | 0029 | 0004 | 49 |
| 50 | 0252 | 0227 | 0202 | 0176 | 0151 | 0126 | 0102 | 0077 | 0053 | 0028 | 0004 | 50 |
| 51 | 0252 | 0227 | 0201 | 0176 | 0151 | 0126 | 0101 | 0077 | 0052 | 0028 | 0004 | 51 |
| 52 | 0252 | 0226 | 0201 | 0176 | 0151 | 0126 | 0101 | 0076 | 0052 | 0027 | 0003 | 52 |
| 53 | 0251 | 0226 | 0200 | 0175 | 0150 | 0125 | 0100 | 0076 | 0051 | 0027 | 0003 | 53 |
| 54 | 0251 | 0225 | 0200 | 0175 | 0150 | 0125 | 0100 | 0075 | 0051 | 0027 | 0002 | 54 |
| 55 | 0250 | 0225 | 0200 | 0174 | 0149 | 0124 | 0100 | 0075 | 0051 | 0026 | 0002 | 55 |
| 56 | 0250 | 0224 | 0199 | 0174 | 0149 | 0124 | 0099 | 0075 | 0050 | 0026 | 0002 | 56 |
| 57 | 0250 | 0224 | 0199 | 0174 | 0148 | 0124 | 0099 | 0074 | 0050 | 0025 | 0001 | 57 |
| 58 | 0249 | 0224 | 0198 | 0173 | 0148 | 0123 | 0098 | 0074 | 0049 | 0025 | 0001 | 58 |
| 59 | 0249 | 0223 | 0198 | 0173 | 0148 | 0123 | 0098 | 0073 | 0049 | 0025 | 0000 | 59 |
| 60 | 0248 | 0223 | 0197 | 0172 | 0147 | 0122 | 0098 | 0073 | 0049 | 0024 | 0000 | 60 |

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## To correct the Apparent Distance of the MOON from the SUN or a STAR, for the Effects of Parallax and Refraction.

| Par. in Alt. or Dist. | APPARENT DISTANCE. | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10° | 11° | 12° | 13° | 14° | 15° | 16° | 17° | 18° | 19° | 20° | 21° | 22° | 23° | 24° | 25° | 26° | 27° | 28° | 29° | 30° |
| | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 11 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 12 | 7 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| 13 | 8 | 8 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 14 | 10 | 9 | 8 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| 15 | 11 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| 16 | 13 | 11 | 11 | 10 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 |
| 17 | 14 | 13 | 12 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 |
| 18 | 16 | 15 | 13 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 5 |
| 19 | 18 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 |
| 20 | 20 | 18 | 16 | 15 | 14 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 |
| 21 | 22 | 20 | 18 | 17 | 15 | 14 | 13 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 7 |
| 22 | 24 | 22 | 20 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 12 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 |
| 23 | 26 | 24 | 22 | 20 | 19 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 |
| 24 | 28 | 26 | 24 | 22 | 20 | 19 | 18 | 16 | 15 | 15 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 9 |
| 25 | 31 | 28 | 26 | 24 | 22 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 9 |
| 26 | 33 | 30 | 28 | 26 | 24 | 22 | 21 | 19 | 18 | 17 | 16 | 15 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 10 |
| 27 | 36 | 33 | 30 | 28 | 26 | 24 | 22 | 21 | 20 | 18 | 17 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | 11 |
| 28 | 39 | 35 | 32 | 30 | 27 | 26 | 24 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 15 | 14 | 13 | 13 | 12 | 12 |
| 29 | 42 | 38 | 35 | 32 | 29 | 27 | 26 | 24 | 23 | 21 | 20 | 19 | 18 | 17 | 16 | 16 | 15 | 14 | 14 | 13 | 13 |
| 30 | 45 | 40 | 37 | 34 | 31 | 29 | 27 | 26 | 24 | 23 | 22 | 20 | 19 | 19 | 18 | 17 | 16 | 15 | 15 | 14 | 14 |
| 31 | 48 | 43 | 39 | 36 | 34 | 31 | 29 | 27 | 26 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 16 | 15 | 15 |
| 32 | 51 | 46 | 42 | 39 | 36 | 33 | 31 | 29 | 27 | 26 | 25 | 23 | 22 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 15 |
| 33 | 54 | 49 | 45 | 41 | 38 | 35 | 33 | 31 | 29 | 28 | 26 | 25 | 24 | 22 | 21 | 20 | 19 | 19 | 18 | 17 | 16 |
| 34 | 57 | 52 | 47 | 44 | 40 | 38 | 35 | 33 | 31 | 29 | 28 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 |
| 35 | 61 | 55 | 50 | 46 | 43 | 40 | 37 | 35 | 33 | 31 | 29 | 28 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 19 |
| 36 | 64 | 58 | 53 | 49 | 45 | 42 | 39 | 37 | 35 | 33 | 31 | 29 | 28 | 27 | 25 | 24 | 23 | 22 | 21 | 20 | 20 |
| 37 | 68 | 61 | 56 | 52 | 48 | 45 | 42 | 39 | 37 | 35 | 33 | 31 | 30 | 28 | 27 | 26 | 24 | 23 | 22 | 22 | 21 |
| 38 | 71 | 65 | 59 | 55 | 51 | 47 | 44 | 41 | 39 | 37 | 35 | 33 | 31 | 30 | 28 | 27 | 26 | 25 | 24 | 23 | 22 |
| 39 | 75 | 68 | 62 | 57 | 53 | 50 | 46 | 43 | 41 | 39 | 36 | 35 | 33 | 31 | 30 | 28 | 27 | 26 | 25 | 24 | 23 |
| 40 | 79 | 72 | 66 | 60 | 56 | 52 | 49 | 46 | 43 | 41 | 38 | 36 | 35 | 33 | 31 | 30 | 29 | 27 | 26 | 25 | 24 |
| 41 | 83 | 75 | 69 | 63 | 59 | 55 | 51 | 48 | 45 | 43 | 40 | 38 | 36 | 35 | 33 | 31 | 30 | 29 | 28 | 26 | 25 |
| 42 | 87 | 79 | 72 | 67 | 62 | 57 | 54 | 50 | 47 | 45 | 42 | 40 | 38 | 36 | 35 | 33 | 32 | 30 | 29 | 28 | 27 |
| 43 | 91 | 83 | 76 | 70 | 65 | 60 | 56 | 53 | 50 | 47 | 44 | 42 | 40 | 38 | 36 | 35 | 33 | 32 | 30 | 29 | 28 |
| 44 | 96 | 87 | 79 | 73 | 68 | 63 | 59 | 55 | 52 | 49 | 46 | 44 | 42 | 40 | 38 | 36 | 35 | 33 | 32 | 30 | 29 |
| 45 | 100 | 91 | 83 | 76 | 71 | 66 | 62 | 58 | 54 | 51 | 49 | 46 | 44 | 42 | 40 | 38 | 36 | 35 | 33 | 32 | 31 |
| 46 | 105 | 95 | 87 | 80 | 74 | 69 | 64 | 60 | 57 | 54 | 51 | 48 | 46 | 43 | 41 | 40 | 38 | 36 | 35 | 33 | 32 |
| 47 | 109 | 99 | 91 | 83 | 77 | 72 | 67 | 63 | 59 | 56 | 53 | 50 | 48 | 45 | 43 | 41 | 40 | 38 | 36 | 35 | 33 |
| 48 | 114 | 103 | 94 | 87 | 81 | 75 | 70 | 66 | 62 | 58 | 55 | 52 | 50 | 47 | 45 | 43 | 41 | 39 | 38 | 36 | 35 |
| 49 | 119 | 108 | 98 | 91 | 84 | 78 | 73 | 68 | 64 | 61 | 58 | 55 | 52 | 49 | 47 | 45 | 43 | 41 | 39 | 38 | 36 |
| 50 | 124 | 112 | 103 | 94 | 87 | 81 | 76 | 71 | 67 | 63 | 60 | 57 | 54 | 51 | 49 | 47 | 45 | 43 | 41 | 39 | 38 |
| 51 | 128 | 117 | 107 | 98 | 91 | 85 | 79 | 74 | 70 | 66 | 62 | 59 | 56 | 53 | 51 | 49 | 47 | 45 | 43 | 41 | 39 |
| 52 | 134 | 121 | 111 | 102 | 95 | 88 | 82 | 77 | 73 | 68 | 65 | 61 | 58 | 56 | 53 | 51 | 48 | 46 | 44 | 43 | 41 |
| 53 | 139 | 126 | 115 | 106 | 98 | 91 | 85 | 80 | 75 | 71 | 67 | 64 | 61 | 58 | 55 | 53 | 50 | 48 | 46 | 44 | 42 |
| 54 | 144 | 131 | 120 | 110 | 102 | 95 | 89 | 83 | 78 | 74 | 70 | 66 | 63 | 60 | 57 | 55 | 52 | 50 | 48 | 46 | 44 |
| 55 | 149 | 136 | 124 | 114 | 106 | 98 | 92 | 86 | 81 | 77 | 72 | 69 | 65 | 62 | 59 | 57 | 54 | 52 | 50 | 48 | 46 |
| 56 | 155 | 141 | 129 | 118 | 110 | 102 | 95 | 89 | 84 | 79 | 75 | 71 | 68 | 64 | 61 | 59 | 56 | 54 | 51 | 49 | 47 |
| 57 | 160 | 146 | 133 | 123 | 114 | 106 | 99 | 93 | 87 | 82 | 78 | 74 | 70 | 67 | 64 | 61 | 58 | 56 | 53 | 51 | 49 |
| 58 | 166 | 151 | 138 | 127 | 118 | 109 | 102 | 96 | 90 | 85 | 81 | 76 | 73 | 69 | 66 | 63 | 60 | 58 | 55 | 53 | 51 |
| 59 | 172 | 156 | 143 | 131 | 122 | 113 | 106 | 99 | 93 | 88 | 83 | 79 | 75 | 72 | 68 | 65 | 62 | 60 | 57 | 55 | 53 |
| 60 | 178 | 161 | 148 | 136 | 126 | 117 | 109 | 103 | 97 | 91 | 86 | 82 | 78 | 74 | 71 | 67 | 64 | 62 | 59 | 57 | 54 |
| 61 | 184 | 167 | 152 | 140 | 130 | 121 | 113 | 106 | 100 | 94 | 89 | 85 | 80 | 76 | 73 | 70 | 67 | 64 | 61 | 59 | 56 |
| 62 | 190 | 172 | 158 | 145 | 134 | 125 | 117 | 110 | 103 | 97 | 92 | 87 | 83 | 79 | 75 | 72 | 69 | 66 | 63 | 60 | 58 |
| | 10° | 11° | 12° | 13° | 14° | 15° | 16° | 17° | 18° | 19° | 20° | 21° | 22° | 23° | 24° | 25° | 26° | 27° | 28° | 29° | 30° |

# TABLE XXXV.

## To correct the Apparent Distance of the MOON from the SUN or a STAR, for the Effects of Parallax and Refraction.

| Par. in Alt. or Dist. | APPARENT DISTANCE. | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | 39° | 40° | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | 50° | 51° |
| M | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 11 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 14 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| 15 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 16 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 17 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| 18 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| 19 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 20 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 21 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| 22 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| 23 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 |
| 24 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 25 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| 26 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 |
| 27 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 |
| 28 | 11 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 |
| 29 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 |
| 30 | 13 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 |
| 31 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 |
| 32 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 |
| 33 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 |
| 34 | 17 | 16 | 16 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 |
| 35 | 18 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 |
| 36 | 19 | 18 | 17 | 17 | 16 | 16 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 9 | 9 |
| 37 | 20 | 19 | 18 | 18 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 10 | 10 |
| 38 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 16 | 15 | 14 | 14 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 |
| 39 | 22 | 21 | 20 | 20 | 19 | 18 | 18 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 |
| 40 | 23 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 16 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 11 |
| 41 | 24 | 23 | 23 | 22 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 |
| 42 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 20 | 19 | 18 | 18 | 17 | 17 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 |
| 43 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 |
| 44 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 22 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 14 |
| 45 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 20 | 19 | 18 | 18 | 17 | 16 | 16 | 15 | 15 | 14 |
| 46 | 31 | 30 | 28 | 27 | 26 | 25 | 25 | 24 | 23 | 22 | 21 | 21 | 20 | 19 | 18 | 18 | 17 | 17 | 16 | 15 | 15 |
| 47 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 16 |
| 48 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 22 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 |
| 49 | 35 | 34 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 22 | 21 | 20 | 20 | 19 | 18 | 18 | 17 |
| 50 | 36 | 35 | 34 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 20 | 19 | 18 | 18 |
| 51 | 38 | 36 | 35 | 34 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 24 | 23 | 22 | 21 | 20 | 20 | 19 | 18 |
| 52 | 39 | 38 | 36 | 35 | 34 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 24 | 23 | 22 | 21 | 21 | 20 | 19 |
| 53 | 41 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 25 | 24 | 23 | 22 | 21 | 21 | 20 |
| 54 | 42 | 41 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 25 | 24 | 23 | 22 | 21 | 21 |
| 55 | 44 | 42 | 41 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 25 | 24 | 23 | 22 | 21 |
| 56 | 46 | 44 | 42 | 41 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 26 | 25 | 24 | 23 | 22 |
| 57 | 47 | 45 | 44 | 42 | 40 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 26 | 25 | 24 | 23 |
| 58 | 49 | 47 | 45 | 44 | 42 | 40 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 26 | 25 | 24 |
| 59 | 51 | 49 | 47 | 45 | 43 | 42 | 40 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 25 |
| 60 | 52 | 50 | 48 | 47 | 45 | 43 | 42 | 40 | 39 | 37 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 26 | 25 |
| 61 | 54 | 52 | 50 | 48 | 46 | 45 | 43 | 42 | 40 | 39 | 37 | 36 | 35 | 34 | 32 | 31 | 30 | 29 | 28 | 27 | 26 |
| 62 | 56 | 54 | 52 | 50 | 48 | 46 | 45 | 43 | 41 | 40 | 39 | 37 | 36 | 35 | 34 | 32 | 31 | 30 | 29 | 28 | 27 |
| | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | 39° | 40° | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | 50° | 51° |

# TABLE XXXV.

## To correct the Apparent Distance of the MOON from the SUN or a STAR, for the Effects of Parallax and Refraction.

| Par. in Alt. or Dist. | APPARENT DISTANCE. | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° 52 | ° 53 | ° 54 | ° 55 | ° 56 | ° 57 | ° 58 | ° 59 | ° 60 | ° 65 | ° 70 | ° 75 | ° 80 | ° 85 | ° 90 | ° 95 | ° 100 | ° 105 | ° 110 | ° 115 | ° 120 |
| M | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 20 | 20 | 20 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 20 | 20 | 20 |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 20 | 20 | 19 |
| 11 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 20 | 20 | 19 |
| 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 20 | 19 | 19 |
| 13 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 19 | 19 | 19 |
| 14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 19 | 19 | 19 |
| 15 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 20 | 20 | 19 | 19 | 19 | 19 |
| 16 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 20 | 20 | 19 | 19 | 19 | 19 |
| 17 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 20 | 20 | 19 | 19 | 19 | 19 |
| 18 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 20 | 20 | 19 | 19 | 19 | 18 |
| 19 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 20 | 19 | 19 | 19 | 19 | 18 |
| 20 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 20 | 19 | 19 | 19 | 18 | 18 |
| 21 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 20 | 19 | 19 | 19 | 18 | 18 |
| 22 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 20 | 19 | 19 | 18 | 18 | 18 |
| 23 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 20 | 19 | 19 | 18 | 18 | 17 |
| 24 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 20 | 19 | 19 | 18 | 18 | 17 |
| 25 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 0 | 0 | 20 | 19 | 19 | 18 | 17 | 17 |
| 26 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 0 | 19 | 19 | 18 | 18 | 17 | 17 |
| 27 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 2 | 2 | 1 | 1 | 0 | 19 | 19 | 18 | 18 | 17 | 16 |
| 28 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 2 | 2 | 1 | 1 | 0 | 19 | 19 | 18 | 18 | 17 | 16 |
| 29 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 1 | 1 | 0 | 19 | 19 | 18 | 17 | 17 | 16 |
| 30 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 3 | 2 | 1 | 1 | 0 | 19 | 19 | 18 | 17 | 16 | 15 |
| 31 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 3 | 2 | 1 | 1 | 0 | 19 | 19 | 18 | 17 | 16 | 15 |
| 32 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 4 | 3 | 2 | 2 | 1 | 0 | 19 | 18 | 18 | 17 | 16 | 15 |
| 33 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 4 | 3 | 3 | 2 | 1 | 0 | 19 | 18 | 17 | 17 | 16 | 15 |
| 34 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 19 | 18 | 17 | 16 | 15 | 14 |
| 35 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 19 | 18 | 17 | 16 | 15 | 14 |
| 36 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 5 | 4 | 3 | 2 | 1 | 0 | 19 | 18 | 17 | 16 | 15 | 13 |
| 37 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 4 | 3 | 2 | 1 | 0 | 19 | 18 | 17 | 16 | 14 | 13 |
| 38 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 6 | 5 | 3 | 2 | 1 | 0 | 19 | 18 | 17 | 15 | 14 | 13 |
| 39 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 6 | 5 | 4 | 2 | 1 | 0 | 19 | 18 | 16 | 15 | 14 | 12 |
| 40 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 5 | 4 | 2 | 1 | 0 | 19 | 18 | 16 | 15 | 13 | 12 |
| 41 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 8 | 7 | 5 | 4 | 3 | 1 | 0 | 19 | 17 | 16 | 15 | 13 | 12 |
| 42 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 7 | 6 | 4 | 3 | 1 | 0 | 19 | 17 | 16 | 14 | 13 | 11 |
| 43 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 8 | 6 | 4 | 3 | 1 | 0 | 19 | 17 | 16 | 14 | 12 | 11 |
| 44 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 8 | 6 | 5 | 3 | 1 | 0 | 19 | 17 | 15 | 14 | 12 | 10 |
| 45 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 8 | 6 | 5 | 3 | 2 | 0 | 18 | 17 | 15 | 14 | 12 | 10 |
| 46 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 9 | 7 | 5 | 3 | 2 | 0 | 18 | 17 | 15 | 13 | 11 | 9 |
| 47 | 15 | 15 | 14 | 13 | 13 | 13 | 12 | 12 | 11 | 9 | 7 | 5 | 3 | 2 | 0 | 18 | 17 | 15 | 13 | 11 | 9 |
| 48 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 9 | 7 | 5 | 4 | 2 | 0 | 18 | 16 | 15 | 13 | 11 | 8 |
| 49 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 10 | 8 | 6 | 4 | 2 | 0 | 18 | 16 | 14 | 12 | 10 | 8 |
| 50 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 10 | 8 | 6 | 4 | 2 | 0 | 18 | 16 | 14 | 12 | 10 | 7 |
| 51 | 18 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 11 | 8 | 6 | 4 | 2 | 0 | 18 | 16 | 14 | 12 | 9 | 7 |
| 52 | 18 | 18 | 17 | 17 | 16 | 15 | 15 | 14 | 14 | 11 | 9 | 6 | 4 | 2 | 0 | 18 | 16 | 14 | 11 | 9 | 6 |
| 53 | 19 | 18 | 18 | 17 | 17 | 16 | 15 | 15 | 14 | 11 | 9 | 7 | 4 | 2 | 0 | 18 | 16 | 13 | 11 | 9 | 6 |
| 54 | 20 | 19 | 18 | 18 | 17 | 17 | 16 | 15 | 15 | 12 | 9 | 7 | 4 | 2 | 0 | 18 | 16 | 13 | 11 | 8 | 5 |
| 55 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 16 | 15 | 12 | 10 | 7 | 5 | 2 | 0 | 18 | 15 | 13 | 10 | 8 | 5 |
| 56 | 21 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 16 | 13 | 10 | 7 | 5 | 2 | 0 | 18 | 15 | 13 | 10 | 7 | 4 |
| 57 | 22 | 21 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 13 | 10 | 8 | 5 | 2 | 0 | 18 | 15 | 12 | 10 | 7 | 4 |
| 58 | 23 | 22 | 21 | 21 | 20 | 19 | 18 | 18 | 17 | 14 | 11 | 8 | 5 | 3 | 0 | 17 | 15 | 12 | 9 | 6 | 3 |
| 59 | 24 | 23 | 22 | 21 | 20 | 20 | 19 | 18 | 18 | 14 | 11 | 8 | 5 | 3 | 0 | 17 | 15 | 12 | 9 | 6 | 2 |
| 60 | 25 | 24 | 23 | 22 | 21 | 20 | 20 | 19 | 18 | 15 | 11 | 8 | 6 | 3 | 0 | 17 | 14 | 12 | 9 | 5 | 2 |
| 61 | 25 | 24 | 24 | 23 | 22 | 21 | 20 | 20 | 19 | 15 | 12 | 9 | 6 | 3 | 0 | 17 | 14 | 11 | 8 | 5 | 1 |
| 62 | 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 19 | 16 | 12 | 9 | 6 | 3 | 0 | 17 | 14 | 11 | 8 | 4 | 1 |
| | ° 52 | ° 53 | ° 54 | ° 55 | ° 56 | ° 57 | ° 58 | ° 59 | ° 60 | ° 65 | ° 70 | ° 75 | ° 80 | ° 85 | ° 90 | ° 95 | ° 100 | ° 105 | ° 110 | ° 115 | ° 120 |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 0° Versed | 0° Parts for ″ | 0° Suvers. | 1° Versed | 1° Parts for ″ | 1° Suvers. | 2° Versed | 2° Parts for ″ | 2° Suvers. | 3° Versed | 3° Parts for ″ | 3° Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 000000 | 0 | 2.000000 | 000152 | 0 | 1.999848 | 000609 | 0 | 1.999391 | 001370 | 0 | 1.998630 | 60 |
| 1 | 00000 | 0 | 00000 | 00157 | 0 | 99843 | 00619 | 0 | 99381 | 01386 | 0 | 98614 | 59 |
| 2 | 00000 | 0 | 00000 | 00163 | 0 | 99837 | 00630 | 0 | 99370 | 01401 | 1 | 98599 | 58 |
| 3 | 00000 | 0 | 00000 | 00168 | 0 | 99832 | 00640 | 1 | 99360 | 01416 | 1 | 98584 | 57 |
| 4 | 00001 | 0 | 1.999999 | 00173 | 0 | 99827 | 00650 | 1 | 99350 | 01432 | 1 | 98568 | 56 |
| 5 | 00001 | 0 | 99999 | 00179 | 0 | 99821 | 00661 | 1 | 99339 | 01448 | 1 | 98552 | 55 |
| 6 | 00001 | 0 | 99999 | 00184 | 1 | 99816 | 00672 | 1 | 99328 | 01463 | 2 | 98537 | 54 |
| 7 | 00002 | 0 | 99998 | 00190 | 1 | 99810 | 00682 | 1 | 99318 | 01479 | 2 | 98521 | 53 |
| 8 | 00003 | 1 | 99997 | 00196 | 1 | 99804 | 00693 | 1 | 99307 | 01495 | 2 | 98505 | 52 |
| 9 | 00003 | 1 | 99997 | 00201 | 1 | 99799 | 00704 | 2 | 99296 | 01511 | 2 | 98489 | 51 |
| 10 | 00004 | 1 | 99996 | 00207 | 1 | 99793 | 00715 | 2 | 99285 | 01527 | 3 | 98473 | 50 |
| 11 | 000005 | 1 | 1.999995 | 000213 | 1 | 1.999787 | 000726 | 2 | 1.999274 | 001543 | 3 | 1.998457 | 49 |
| 12 | 00006 | 1 | 99994 | 00219 | 1 | 99781 | 00737 | 2 | 99263 | 01559 | 3 | 98441 | 48 |
| 13 | 00007 | 1 | 99993 | 00226 | 1 | 99774 | 00748 | 2 | 99252 | 01575 | 4 | 98425 | 47 |
| 14 | 00008 | 1 | 99992 | 00232 | 1 | 99768 | 00760 | 3 | 99240 | 01592 | 4 | 98408 | 46 |
| 15 | 00009 | 1 | 99991 | 00238 | 2 | 99762 | 00771 | 3 | 99229 | 01608 | 4 | 98392 | 45 |
| 16 | 00011 | 1 | 99989 | 00244 | 2 | 99756 | 00782 | 3 | 99218 | 01625 | 4 | 98375 | 44 |
| 17 | 00012 | 1 | 99988 | 00251 | 2 | 99749 | 00794 | 3 | 99206 | 01641 | 4 | 98359 | 43 |
| 18 | 00014 | 1 | 99986 | 00257 | 2 | 99743 | 00806 | 3 | 99194 | 01658 | 5 | 98342 | 42 |
| 19 | 00015 | 1 | 99985 | 00264 | 2 | 99736 | 00817 | 4 | 99183 | 01675 | 5 | 98325 | 41 |
| 20 | 00017 | 1 | 99983 | 00271 | 2 | 99729 | 00829 | 4 | 99171 | 01692 | 5 | 98308 | 40 |
| 21 | 000019 | 1 | 1.999981 | 000278 | 2 | 1.999722 | 000841 | 4 | 1.999159 | 001709 | 6 | 1.998291 | 39 |
| 22 | 00020 | 2 | 99980 | 00284 | 2 | 99716 | 00853 | 4 | 99147 | 01726 | 6 | 98274 | 38 |
| 23 | 00022 | 2 | 99978 | 00291 | 2 | 99709 | 00865 | 4 | 99135 | 01743 | 6 | 98257 | 37 |
| 24 | 00024 | 2 | 99976 | 00299 | 3 | 99701 | 00877 | 5 | 99123 | 01760 | 7 | 98240 | 36 |
| 25 | 00026 | 2 | 99974 | 00306 | 3 | 99694 | 00889 | 5 | 99111 | 01777 | 7 | 98223 | 35 |
| 26 | 00029 | 2 | 99971 | 00313 | 3 | 99687 | 00902 | 5 | 99098 | 01795 | 7 | 98205 | 34 |
| 27 | 00031 | 2 | 99969 | 00320 | 3 | 99680 | 00914 | 5 | 99086 | 01812 | 8 | 98188 | 33 |
| 28 | 00033 | 2 | 99967 | 00328 | 3 | 99672 | 00927 | 5 | 99073 | 01830 | 8 | 98170 | 32 |
| 29 | 00036 | 2 | 99964 | 00335 | 3 | 99665 | 00939 | 6 | 99061 | 01847 | 8 | 98153 | 31 |
| 30 | 00038 | 2 | 99962 | 00343 | 3 | 99657 | 00952 | 6 | 99048 | 01865 | 9 | 98135 | 30 |
| 31 | 000041 | 2 | 1.999959 | 000350 | 4 | 1.999650 | 000964 | 7 | 1.999036 | 001883 | 9 | 1.998117 | 29 |
| 32 | 00043 | 2 | 99957 | 00358 | 4 | 99642 | 00977 | 7 | 99023 | 01901 | 10 | 98099 | 28 |
| 33 | 00046 | 2 | 99954 | 00366 | 4 | 99634 | 00990 | 7 | 99010 | 01919 | 10 | 98081 | 27 |
| 34 | 00049 | 2 | 99951 | 00374 | 4 | 99626 | 01003 | 8 | 98997 | 01937 | 11 | 98063 | 26 |
| 35 | 00052 | 2 | 99948 | 00382 | 4 | 99618 | 01016 | 8 | 98984 | 01955 | 11 | 98045 | 25 |
| 36 | 00055 | 2 | 99945 | 00390 | 5 | 99610 | 01029 | 8 | 98971 | 01973 | 11 | 98027 | 24 |
| 37 | 00058 | 2 | 99942 | 00398 | 5 | 99602 | 01043 | 9 | 98957 | 01992 | 12 | 98008 | 23 |
| 38 | 00061 | 2 | 99939 | 00406 | 5 | 99594 | 01056 | 9 | 98944 | 02010 | 12 | 97990 | 22 |
| 39 | 00064 | 2 | 99936 | 00415 | 5 | 99585 | 01069 | 9 | 98931 | 02028 | 12 | 97972 | 21 |
| 40 | 00068 | 2 | 99932 | 00423 | 6 | 99577 | 01083 | 9 | 98917 | 02047 | 13 | 97953 | 20 |
| 41 | 000071 | 2 | 1.999929 | 000432 | 6 | 1.999568 | 001096 | 10 | 1.998904 | 002066 | 13 | 1.997934 | 19 |
| 42 | 00075 | 2 | 99925 | 00440 | 6 | 99560 | 01110 | 10 | 98890 | 02084 | 13 | 97916 | 18 |
| 43 | 00078 | 2 | 99922 | 00449 | 6 | 99551 | 01124 | 10 | 98876 | 02103 | 14 | 97897 | 17 |
| 44 | 00082 | 2 | 99918 | 00458 | 6 | 99542 | 01138 | 10 | 98862 | 02122 | 14 | 97878 | 16 |
| 45 | 00086 | 3 | 99914 | 00466 | 6 | 99534 | 01152 | 11 | 98848 | 02141 | 14 | 97859 | 15 |
| 46 | 00089 | 3 | 99911 | 00475 | 6 | 99525 | 01166 | 11 | 98834 | 02160 | 15 | 97840 | 14 |
| 47 | 00093 | 3 | 99907 | 00484 | 7 | 99516 | 01180 | 11 | 98820 | 02179 | 15 | 97821 | 13 |
| 48 | 00097 | 3 | 99903 | 00493 | 7 | 99507 | 01194 | 11 | 98806 | 02198 | 15 | 97802 | 12 |
| 49 | 00102 | 3 | 99898 | 00503 | 7 | 99497 | 01208 | 11 | 98792 | 02218 | 16 | 97782 | 11 |
| 50 | 00106 | 3 | 99894 | 00512 | 7 | 99488 | 01222 | 12 | 98778 | 02237 | 16 | 97763 | 10 |
| 51 | 000110 | 3 | 1.999890 | 000521 | 7 | 1.999479 | 001237 | 12 | 1.998763 | 002257 | 16 | 1.997743 | 9 |
| 52 | 00114 | 3 | 99886 | 00531 | 7 | 99469 | 01251 | 12 | 98749 | 02276 | 16 | 97724 | 8 |
| 53 | 00119 | 3 | 99881 | 00540 | 8 | 99460 | 01266 | 12 | 98734 | 02296 | 17 | 97704 | 7 |
| 54 | 00123 | 3 | 99877 | 00550 | 8 | 99450 | 01281 | 13 | 98719 | 02316 | 17 | 97684 | 6 |
| 55 | 00128 | 3 | 99872 | 00559 | 8 | 99441 | 01295 | 13 | 98705 | 02335 | 17 | 97665 | 5 |
| 56 | 00133 | 3 | 99867 | 00569 | 8 | 99431 | 01310 | 13 | 98690 | 02355 | 18 | 97645 | 4 |
| 57 | 00137 | 3 | 99863 | 00579 | 8 | 99421 | 01325 | 14 | 98675 | 02375 | 18 | 97625 | 3 |
| 58 | 00142 | 3 | 99858 | 00589 | 8 | 99411 | 01340 | 14 | 98660 | 02395 | 18 | 97605 | 2 |
| 59 | 00147 | 3 | 99853 | 00599 | 8 | 99401 | 01355 | 14 | 98645 | 02416 | 19 | 97584 | 1 |
| 60 | 000152 | 4 | 1.999848 | 000609 | 9 | 1.999391 | 001370 | 14 | 1.998630 | 002436 | 19 | 1.997564 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 179° | | | 178° | | | 177° | | | 176° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 4° Versed | Parts for ″ | Suvers. | 5° Versed | Parts for ″ | Suvers. | 6° Versed | Parts for ″ | Suvers. | 7° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 002436 | 0 | 1.997564 | 003805 | 0 | 1.996195 | 005478 | 0 | 1.994522 | 007454 | 0 | 1.992546 | 60 |
| 1 | 02456 | 0 | 97544 | 03831 | 0 | 96169 | 05509 | 1 | 94491 | 07489 | 1 | 92511 | 59 |
| 2 | 02477 | 1 | 97523 | 03856 | 1 | 96144 | 05539 | 1 | 94461 | 07525 | 1 | 92475 | 58 |
| 3 | 02497 | 1 | 97503 | 03882 | 1 | 96118 | 05570 | 2 | 94430 | 07561 | 2 | 92439 | 57 |
| 4 | 02518 | 1 | 97482 | 03907 | 2 | 96093 | 05600 | 2 | 94400 | 07596 | 2 | 92404 | 56 |
| 5 | 02538 | 2 | 97462 | 03933 | 2 | 96067 | 05631 | 3 | 94369 | 07632 | 3 | 92368 | 55 |
| 6 | 02559 | 2 | 97441 | 03959 | 3 | 96041 | 05662 | 3 | 94338 | 07668 | 4 | 92332 | 54 |
| 7 | 02580 | 3 | 97420 | 03985 | 3 | 96015 | 05693 | 4 | 94307 | 07704 | 4 | 92296 | 53 |
| 8 | 02601 | 3 | 97399 | 04011 | 3 | 95989 | 05724 | 4 | 94276 | 07740 | 5 | 92260 | 52 |
| 9 | 02622 | 3 | 97378 | 04037 | 4 | 95963 | 05755 | 5 | 94245 | 07776 | 6 | 92224 | 51 |
| 10 | 02643 | 4 | 97357 | 04063 | 4 | 95937 | 05786 | 5 | 94214 | 07813 | 6 | 92187 | 50 |
| 11 | 002664 | 4 | 1.997336 | 004089 | 5 | 1.995911 | 005818 | 6 | 1.994182 | 007849 | 7 | 1.992151 | 49 |
| 12 | 02685 | 4 | 97315 | 04116 | 5 | 95884 | 05849 | 6 | 94151 | 07885 | 7 | 92115 | 48 |
| 13 | 02707 | 5 | 97293 | 04142 | 6 | 95858 | 05880 | 7 | 94120 | 07922 | 8 | 92078 | 47 |
| 14 | 02728 | 5 | 97272 | 04168 | 6 | 95832 | 05912 | 7 | 94088 | 07958 | 9 | 92042 | 46 |
| 15 | 02750 | 5 | 97250 | 04195 | 7 | 95805 | 05944 | 8 | 94056 | 07995 | 9 | 92005 | 45 |
| 16 | 02771 | 6 | 97229 | 04222 | 7 | 95778 | 05975 | 8 | 94025 | 08032 | 10 | 91968 | 44 |
| 17 | 02793 | 6 | 97207 | 04248 | 7 | 95752 | 06007 | 9 | 93993 | 08069 | 10 | 91931 | 43 |
| 18 | 02815 | 6 | 97185 | 04275 | 8 | 95725 | 06039 | 9 | 93961 | 08106 | 11 | 91894 | 42 |
| 19 | 02837 | 7 | 97163 | 04302 | 8 | 95698 | 06071 | 10 | 93929 | 08143 | 12 | 91857 | 41 |
| 20 | 02859 | 7 | 97141 | 04329 | 9 | 95671 | 06103 | 10 | 93897 | 08180 | 12 | 91820 | 40 |
| 21 | 002881 | 7 | 1.997119 | 004356 | 9 | 1.995644 | 006135 | 11 | 1.993865 | 008217 | 13 | 1.991783 | 39 |
| 22 | 02903 | 8 | 97097 | 04383 | 10 | 95617 | 06167 | 11 | 93833 | 08254 | 13 | 91746 | 38 |
| 23 | 02925 | 8 | 97075 | 04411 | 10 | 95589 | 06200 | 12 | 93800 | 08291 | 14 | 91709 | 37 |
| 24 | 02947 | 8 | 97053 | 04438 | 11 | 95562 | 06232 | 13 | 93768 | 08329 | 15 | 91671 | 36 |
| 25 | 02970 | 9 | 97030 | 04465 | 11 | 95535 | 06264 | 13 | 93736 | 08366 | 15 | 91634 | 35 |
| 26 | 02992 | 9 | 97008 | 04493 | 11 | 95507 | 06297 | 14 | 93703 | 08404 | 16 | 91596 | 34 |
| 27 | 03015 | 10 | 96985 | 04520 | 12 | 95480 | 06330 | 14 | 93670 | 08442 | 17 | 91558 | 33 |
| 28 | 03037 | 10 | 96963 | 04548 | 12 | 95452 | 06362 | 15 | 93638 | 08479 | 17 | 91521 | 32 |
| 29 | 03060 | 11 | 96940 | 04576 | 13 | 95424 | 06395 | 15 | 93605 | 08517 | 18 | 91483 | 31 |
| 30 | 03083 | 11 | 96917 | 04604 | 14 | 95396 | 06428 | 16 | 93572 | 08555 | 19 | 91445 | 30 |
| 31 | 003105 | 12 | 1.996895 | 004632 | 15 | 1.995368 | 006461 | 17 | 1.993539 | 008593 | 20 | 1.991407 | 29 |
| 32 | 03128 | 13 | 96872 | 04660 | 15 | 95340 | 06494 | 18 | 93506 | 08631 | 21 | 91369 | 28 |
| 33 | 03151 | 13 | 96849 | 04688 | 16 | 95312 | 06527 | 19 | 93473 | 08669 | 22 | 91331 | 27 |
| 34 | 03175 | 14 | 96825 | 04716 | 16 | 95284 | 06560 | 19 | 93440 | 08708 | 22 | 91292 | 26 |
| 35 | 03198 | 14 | 96802 | 04744 | 17 | 95256 | 06594 | 20 | 93406 | 08746 | 23 | 91254 | 25 |
| 36 | 03221 | 15 | 96779 | 04773 | 18 | 95227 | 06627 | 21 | 93373 | 08784 | 24 | 91216 | 24 |
| 37 | 03244 | 15 | 96756 | 04801 | 18 | 95199 | 06661 | 21 | 93339 | 08823 | 24 | 91177 | 23 |
| 38 | 03268 | 16 | 96732 | 04829 | 19 | 95171 | 06694 | 22 | 93306 | 08862 | 25 | 91138 | 22 |
| 39 | 03291 | 16 | 96709 | 04858 | 19 | 95142 | 06728 | 22 | 93272 | 08900 | 26 | 91100 | 21 |
| 40 | 03315 | 16 | 96685 | 04887 | 20 | 95113 | 06762 | 23 | 93238 | 08939 | 26 | 91061 | 20 |
| 41 | 003339 | 17 | 1.996661 | 004916 | 20 | 1.995084 | 006795 | 23 | 1.993205 | 008978 | 27 | 1.991022 | 19 |
| 42 | 03363 | 17 | 96637 | 04944 | 21 | 95056 | 06829 | 24 | 93171 | 09017 | 28 | 90983 | 18 |
| 43 | 03386 | 17 | 96614 | 04973 | 21 | 95027 | 06863 | 24 | 93137 | 09056 | 28 | 90944 | 17 |
| 44 | 03410 | 18 | 96590 | 05002 | 21 | 94998 | 06897 | 25 | 93103 | 09095 | 29 | 90905 | 16 |
| 45 | 03434 | 18 | 96566 | 05031 | 22 | 94969 | 06931 | 26 | 93069 | 09134 | 30 | 90866 | 15 |
| 46 | 03459 | 19 | 96541 | 05061 | 22 | 94939 | 06966 | 26 | 93034 | 09173 | 30 | 90827 | 14 |
| 47 | 03483 | 19 | 96517 | 05090 | 23 | 94910 | 07000 | 27 | 93000 | 09213 | 31 | 90787 | 13 |
| 48 | 03507 | 20 | 96493 | 05119 | 23 | 94881 | 07034 | 28 | 92966 | 09252 | 32 | 90748 | 12 |
| 49 | 03531 | 20 | 96469 | 05149 | 24 | 94851 | 07069 | 28 | 92931 | 09292 | 32 | 90708 | 11 |
| 50 | 03556 | 20 | 96444 | 05178 | 25 | 94822 | 07103 | 29 | 92896 | 09331 | 33 | 90669 | 10 |
| 51 | 003580 | 21 | 1.996420 | 005208 | 25 | 1.994792 | 007138 | 29 | 1.992862 | 009371 | 34 | 1.990629 | 9 |
| 52 | 03605 | 21 | 96395 | 05237 | 26 | 94763 | 07173 | 30 | 92827 | 09411 | 34 | 90589 | 8 |
| 53 | 03630 | 22 | 96370 | 05267 | 26 | 94733 | 07208 | 30 | 92792 | 09451 | 35 | 90549 | 7 |
| 54 | 03655 | 22 | 96345 | 05297 | 27 | 94703 | 07243 | 31 | 92757 | 09490 | 36 | 90510 | 6 |
| 55 | 03680 | 22 | 96320 | 05327 | 27 | 94673 | 07278 | 31 | 92722 | 09531 | 36 | 90469 | 5 |
| 56 | 03705 | 23 | 96295 | 05357 | 28 | 94643 | 07313 | 32 | 92687 | 09571 | 37 | 90429 | 4 |
| 57 | 03730 | 23 | 96270 | 05387 | 28 | 94613 | 07348 | 32 | 92652 | 09611 | 38 | 90389 | 3 |
| 58 | 03755 | 24 | 96245 | 05417 | 29 | 94583 | 07383 | 33 | 92617 | 09651 | 38 | 90349 | 2 |
| 59 | 03780 | 24 | 96220 | 05448 | 29 | 94552 | 07418 | 34 | 92582 | 09691 | 39 | 90309 | 1 |
| 60 | 003805 | 24 | 1.996195 | 005478 | 29 | 1.994522 | 007454 | 34 | 1.992546 | 009732 | 39 | 1.990268 | 0 |
| ″ Vers. | 175° Suvers. | Parts for ″ | Versed. | 174° Suvers. | Parts for ″ | Versed. | 173° Suvers. | Parts for ″ | Versed. | 172° Suvers. | Parts for ″ | Versed. | ″ ′ Suv. |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 8° Versed | 8° Parts for ″ | 8° Suvers. | 9° Versed | 9° Parts for ″ | 9° Suvers. | 10° Versed | 10° Parts for ″ | 10° Suvers. | 11° Versed | 11° Parts for ″ | 11° Suvers. | ′ ″ Sun. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 009732 | 0 | 1.990268 | 012312 | 0 | 1.987688 | 015192 | 0 | 1.984808 | 018373 | 0 | 1.981627 | 60 |
| 1 | 09772 | 1 | 90228 | 12357 | 1 | 87643 | 15243 | 1 | 84757 | 18428 | 1 | 81572 | 59 |
| 2 | 09813 | 1 | 90187 | 12403 | 1 | 87597 | 15293 | 2 | 84707 | 18484 | 2 | 81516 | 58 |
| 3 | 09854 | 2 | 90146 | 12449 | 2 | 87551 | 15344 | 3 | 84656 | 18540 | 3 | 81460 | 57 |
| 4 | 09894 | 3 | 90106 | 12494 | 3 | 87506 | 15395 | 3 | 84605 | 18595 | 4 | 81405 | 56 |
| 5 | 09935 | 3 | 90065 | 12540 | 4 | 87460 | 15446 | 4 | 84554 | 18651 | 5 | 81349 | 55 |
| 6 | 09976 | 4 | 90024 | 12586 | 5 | 87414 | 15497 | 5 | 84503 | 18707 | 6 | 81293 | 54 |
| 7 | 10017 | 5 | 89983 | 12632 | 6 | 87368 | 15548 | 6 | 84452 | 18763 | 7 | 81237 | 53 |
| 8 | 10058 | 6 | 89942 | 12678 | 7 | 87322 | 15599 | 7 | 84401 | 18819 | 7 | 81181 | 52 |
| 9 | 10100 | 6 | 89900 | 12725 | 8 | 87275 | 15650 | 8 | 84350 | 18876 | 8 | 81124 | 51 |
| 10 | 10141 | 7 | 89859 | 12771 | 8 | 87229 | 15701 | 9 | 84299 | 18932 | 9 | 81068 | 50 |
| 11 | 010182 | 8 | 1.989818 | 012817 | 9 | 1.987183 | 015753 | 9 | 1.984247 | 018988 | 10 | 1.981012 | 49 |
| 12 | 10224 | 8 | 89776 | 12864 | 10 | 87136 | 15804 | 10 | 84196 | 19045 | 11 | 80955 | 48 |
| 13 | 10265 | 9 | 89735 | 12910 | 11 | 87090 | 15856 | 11 | 84144 | 19101 | 12 | 80899 | 47 |
| 14 | 10307 | 10 | 89693 | 12957 | 12 | 87043 | 15908 | 12 | 84092 | 19158 | 13 | 80842 | 46 |
| 15 | 10349 | 10 | 89651 | 13004 | 12 | 86996 | 15959 | 13 | 84041 | 19215 | 14 | 80785 | 45 |
| 16 | 10390 | 11 | 89610 | 13050 | 13 | 86950 | 16011 | 14 | 83989 | 19271 | 15 | 80729 | 44 |
| 17 | 10432 | 12 | 89568 | 13097 | 13 | 86903 | 16063 | 15 | 83937 | 19328 | 16 | 80672 | 43 |
| 18 | 10474 | 12 | 89526 | 13144 | 14 | 86856 | 16115 | 16 | 83885 | 19385 | 17 | 80615 | 42 |
| 19 | 10516 | 13 | 89484 | 13191 | 15 | 86809 | 16167 | 16 | 83833 | 19442 | 18 | 80558 | 41 |
| 20 | 10558 | 14 | 89442 | 13238 | 15 | 86762 | 16219 | 17 | 83781 | 19499 | 19 | 80501 | 40 |
| 21 | 010601 | 14 | 1.989399 | 013286 | 16 | 1.986714 | 016271 | 18 | 1.983729 | 019557 | 20 | 1.980443 | 39 |
| 22 | 10643 | 15 | 89357 | 13333 | 17 | 86667 | 16324 | 19 | 83676 | 19614 | 21 | 80386 | 38 |
| 23 | 10685 | 16 | 89315 | 13380 | 18 | 86620 | 16376 | 20 | 83624 | 19671 | 22 | 80329 | 37 |
| 24 | 10728 | 17 | 89272 | 13428 | 19 | 86572 | 16428 | 21 | 83572 | 19729 | 23 | 80271 | 36 |
| 25 | 10770 | 17 | 89230 | 13475 | 19 | 86525 | 16481 | 22 | 83519 | 19786 | 24 | 80214 | 35 |
| 26 | 10813 | 18 | 89187 | 13523 | 20 | 86477 | 16534 | 22 | 83466 | 19844 | 25 | 80156 | 34 |
| 27 | 10855 | 19 | 89145 | 13571 | 21 | 86429 | 16586 | 23 | 83414 | 19902 | 26 | 80098 | 33 |
| 28 | 10898 | 19 | 89102 | 13618 | 22 | 86382 | 16639 | 24 | 83361 | 19959 | 27 | 80041 | 32 |
| 29 | 10941 | 20 | 89059 | 13666 | 23 | 86334 | 16692 | 25 | 83308 | 20017 | 28 | 79983 | 31 |
| 30 | 10984 | 21 | 89016 | 13714 | 24 | 86286 | 16745 | 26 | 83255 | 20075 | 29 | 79925 | 30 |
| 31 | 011027 | 22 | 1.988973 | 013762 | 25 | 1.986238 | 016798 | 27 | 1.983202 | 020133 | 30 | 1.979867 | 29 |
| 32 | 11070 | 23 | 88930 | 13811 | 26 | 86189 | 16851 | 28 | 83149 | 20191 | 31 | 79809 | 28 |
| 33 | 11113 | 24 | 88887 | 13859 | 27 | 86141 | 16904 | 29 | 83096 | 20250 | 32 | 79750 | 27 |
| 34 | 11157 | 25 | 88843 | 13907 | 28 | 86093 | 16958 | 30 | 83042 | 20308 | 33 | 79692 | 26 |
| 35 | 11200 | 26 | 88800 | 13955 | 29 | 86045 | 17011 | 31 | 82989 | 20366 | 34 | 79634 | 25 |
| 36 | 11244 | 26 | 88756 | 14004 | 30 | 85996 | 17065 | 32 | 82935 | 20425 | 35 | 79575 | 24 |
| 37 | 11287 | 27 | 88713 | 14052 | 31 | 85948 | 17118 | 33 | 82882 | 20483 | 36 | 79517 | 23 |
| 38 | 11331 | 28 | 88669 | 14101 | 32 | 85899 | 17172 | 34 | 82828 | 20542 | 37 | 79458 | 22 |
| 39 | 11374 | 28 | 88626 | 14150 | 33 | 85850 | 17226 | 35 | 82774 | 20601 | 38 | 79399 | 21 |
| 40 | 11418 | 29 | 88582 | 14199 | 33 | 85801 | 17279 | 36 | 82721 | 20659 | 39 | 79341 | 20 |
| 41 | 011462 | 30 | 1.988538 | 014248 | 34 | 1.985752 | 017333 | 37 | 1.982667 | 020718 | 40 | 1.979282 | 19 |
| 42 | 11506 | 31 | 88494 | 14296 | 35 | 85704 | 17387 | 38 | 82613 | 20777 | 41 | 79223 | 18 |
| 43 | 11550 | 32 | 88450 | 14346 | 35 | 85654 | 17441 | 39 | 82559 | 20836 | 42 | 79164 | 17 |
| 44 | 11594 | 32 | 88406 | 14395 | 36 | 85605 | 17495 | 40 | 82505 | 20895 | 43 | 79105 | 16 |
| 45 | 11638 | 33 | 88362 | 14444 | 37 | 85556 | 17550 | 41 | 82450 | 20954 | 44 | 79046 | 15 |
| 46 | 11683 | 34 | 88317 | 14493 | 38 | 85507 | 17604 | 41 | 82396 | 21014 | 45 | 78986 | 14 |
| 47 | 11727 | 35 | 88273 | 14543 | 39 | 85457 | 17658 | 42 | 82342 | 21073 | 46 | 78927 | 13 |
| 48 | 11772 | 35 | 88228 | 14592 | 40 | 85408 | 17713 | 43 | 82287 | 21133 | 47 | 78867 | 12 |
| 49 | 11816 | 36 | 88184 | 14642 | 41 | 85358 | 17767 | 44 | 82233 | 21192 | 48 | 78808 | 11 |
| 50 | 11861 | 37 | 88139 | 14691 | 42 | 85309 | 17822 | 45 | 82178 | 21252 | 49 | 78748 | 10 |
| 51 | 011905 | 38 | 1.988095 | 014741 | 42 | 1.985259 | 017877 | 46 | 1.982123 | 021311 | 50 | 1.978689 | 9 |
| 52 | 11950 | 38 | 88050 | 14791 | 43 | 85209 | 17931 | 47 | 82069 | 21371 | 51 | 78629 | 8 |
| 53 | 11995 | 39 | 88005 | 14841 | 44 | 85159 | 17986 | 48 | 82014 | 21431 | 52 | 78569 | 7 |
| 54 | 12040 | 40 | 87960 | 14891 | 45 | 85109 | 18041 | 49 | 81959 | 21491 | 54 | 78509 | 6 |
| 55 | 12085 | 41 | 87915 | 14941 | 45 | 85059 | 18096 | 50 | 81904 | 21551 | 55 | 78449 | 5 |
| 56 | 12130 | 41 | 87870 | 14991 | 46 | 85009 | 18151 | 50 | 81849 | 21611 | 56 | 78389 | 4 |
| 57 | 12175 | 42 | 87825 | 15041 | 47 | 84959 | 18207 | 51 | 81793 | 21671 | 57 | 78329 | 3 |
| 58 | 12221 | 43 | 87779 | 15091 | 48 | 84909 | 18262 | 52 | 81738 | 21732 | 58 | 78268 | 2 |
| 59 | 12266 | 44 | 87734 | 15142 | 49 | 84858 | 18317 | 53 | 81683 | 21792 | 59 | 78208 | 1 |
| 60 | 012312 | 44 | 1.987688 | 015192 | 50 | 1.984808 | 018373 | 54 | 1.981627 | 021852 | 60 | 1.978148 | 0 |
| ″ Vers. | 171° Suvers. | 171° Parts for ″ | 171° Versed. | 170° Suvers. | 170° Parts for ″ | 170° Versed. | 169° Suvers. | 169° Parts for ″ | 169° Versed. | 168° Suvers. | 168° Parts for ″ | 168° Versed. | ′ ″ Sun. |

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 12° Versed | Parts for ″ | Suvers. | 13° Versed | Parts for ″ | Suvers. | 14° Versed | Parts for ″ | Suvers. | 15° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 021852 | 0 | 1.978148 | 025630 | 0 | 1.974370 | 029704 | 0 | 1.970296 | 034074 | 0 | 1.965926 | 60 |
| 1 | 21913 | 1 | 78087 | 25695 | 1 | 74305 | 29775 | 1 | 70225 | 34149 | 1 | 65850 | 59 |
| 2 | 21973 | 2 | 78026 | 25761 | 2 | 74239 | 29845 | 2 | 70155 | 34225 | 2 | 65775 | 58 |
| 3 | 22034 | 3 | 77966 | 25827 | 3 | 74173 | 29916 | 3 | 70084 | 34300 | 4 | 65700 | 57 |
| 4 | 22095 | 4 | 77905 | 25892 | 4 | 74108 | 29986 | 5 | 70014 | 34376 | 5 | 65624 | 56 |
| 5 | 22156 | 5 | 77844 | 25958 | 6 | 74042 | 30057 | 6 | 69943 | 34452 | 6 | 65548 | 55 |
| 6 | 22217 | 6 | 77783 | 26024 | 7 | 73976 | 30128 | 7 | 69872 | 34527 | 8 | 65473 | 54 |
| 7 | 22278 | 7 | 77722 | 26090 | 8 | 73910 | 30199 | 8 | 69801 | 34603 | 9 | 65397 | 53 |
| 8 | 22339 | 8 | 77661 | 26156 | 9 | 73844 | 30270 | 9 | 69730 | 34679 | 10 | 65321 | 52 |
| 9 | 22400 | 9 | 77600 | 26222 | 10 | 73778 | 30341 | 10 | 69659 | 34755 | 11 | 65245 | 51 |
| 10 | 22461 | 10 | 77539 | 26288 | 11 | 73712 | 30412 | 12 | 69588 | 34831 | 13 | 65169 | 50 |
| 11 | 022523 | 11 | 1.977477 | 026355 | 13 | 1.973645 | 030483 | 13 | 1.969517 | 034907 | 14 | 1.965093 | 49 |
| 12 | 22584 | 12 | 77416 | 26421 | 14 | 73579 | 30555 | 14 | 69445 | 34983 | 15 | 65016 | 48 |
| 13 | 22646 | 13 | 77354 | 26488 | 15 | 73512 | 30626 | 15 | 69374 | 35060 | 16 | 64940 | 47 |
| 14 | 22707 | 14 | 77293 | 26554 | 16 | 73446 | 30697 | 16 | 69302 | 35136 | 18 | 64864 | 46 |
| 15 | 22769 | 15 | 77231 | 26621 | 17 | 73379 | 30769 | 18 | 69231 | 35213 | 19 | 64787 | 45 |
| 16 | 22831 | 16 | 77169 | 26687 | 18 | 73313 | 30841 | 19 | 69159 | 35289 | 20 | 64711 | 44 |
| 17 | 22892 | 17 | 77108 | 26754 | 19 | 73246 | 30912 | 20 | 69088 | 35366 | 21 | 64634 | 43 |
| 18 | 22954 | 18 | 77046 | 26821 | 20 | 73179 | 30984 | 21 | 69016 | 35443 | 23 | 64557 | 42 |
| 19 | 23016 | 19 | 76984 | 26888 | 21 | 73112 | 31056 | 22 | 68944 | 35519 | 24 | 64481 | 41 |
| 20 | 23078 | 20 | 76922 | 26955 | 22 | 73045 | 31128 | 24 | 68872 | 35596 | 26 | 64404 | 40 |
| 21 | 023141 | 22 | 1.976859 | 027022 | 24 | 1.972978 | 031200 | 25 | 1.968800 | 035673 | 27 | 1.964327 | 39 |
| 22 | 23203 | 23 | 76797 | 27089 | 25 | 72911 | 31272 | 26 | 68728 | 35750 | 28 | 64250 | 38 |
| 23 | 23265 | 24 | 76735 | 27157 | 26 | 72843 | 31344 | 27 | 68656 | 35827 | 29 | 64173 | 37 |
| 24 | 23328 | 25 | 76672 | 27224 | 27 | 72776 | 31417 | 28 | 68583 | 35905 | 31 | 64095 | 36 |
| 25 | 23390 | 26 | 76610 | 27292 | 28 | 72708 | 31489 | 30 | 68511 | 35982 | 32 | 64018 | 35 |
| 26 | 23453 | 27 | 76547 | 27359 | 29 | 72641 | 31562 | 31 | 68438 | 36059 | 33 | 63941 | 34 |
| 27 | 23515 | 28 | 76485 | 27427 | 30 | 72573 | 31634 | 32 | 68366 | 36137 | 34 | 63863 | 33 |
| 28 | 23578 | 29 | 76422 | 27494 | 31 | 72506 | 31707 | 33 | 68293 | 36214 | 36 | 63786 | 32 |
| 29 | 23641 | 30 | 76359 | 27562 | 32 | 72438 | 31780 | 34 | 68220 | 36292 | 37 | 63708 | 31 |
| 30 | 23704 | 31 | 76296 | 27630 | 34 | 72370 | 31852 | 36 | 68148 | 36369 | 38 | 63631 | 30 |
| 31 | 023767 | 32 | 1.976233 | 027698 | 35 | 1.972302 | 031925 | 37 | 1.968075 | 036447 | 40 | 1.963553 | 29 |
| 32 | 23830 | 33 | 76170 | 27766 | 36 | 72234 | 31998 | 38 | 68002 | 36525 | 42 | 63475 | 28 |
| 33 | 23893 | 35 | 76107 | 27834 | 38 | 72166 | 32071 | 40 | 67929 | 36603 | 43 | 63397 | 27 |
| 34 | 23956 | 36 | 76044 | 27902 | 39 | 72098 | 32144 | 41 | 67856 | 36681 | 44 | 63319 | 26 |
| 35 | 24020 | 37 | 75980 | 27971 | 40 | 72029 | 32217 | 43 | 67783 | 36759 | 46 | 63241 | 25 |
| 36 | 24083 | 38 | 75917 | 28039 | 41 | 71961 | 32291 | 44 | 67709 | 36837 | 47 | 63163 | 24 |
| 37 | 24147 | 39 | 75853 | 28107 | 42 | 71893 | 32364 | 45 | 67636 | 36916 | 48 | 63084 | 23 |
| 38 | 24210 | 40 | 75790 | 28176 | 44 | 71824 | 32438 | 47 | 67562 | 36994 | 49 | 63006 | 22 |
| 39 | 24274 | 41 | 75726 | 28245 | 45 | 71755 | 32511 | 48 | 67489 | 37072 | 51 | 62928 | 21 |
| 40 | 24338 | 42 | 75662 | 28313 | 46 | 71687 | 32585 | 49 | 67415 | 37151 | 52 | 62849 | 20 |
| 41 | 024401 | 43 | 1.975599 | 028382 | 47 | 1.971618 | 032658 | 50 | 1.967342 | 037230 | 53 | 1.962770 | 19 |
| 42 | 24465 | 44 | 75535 | 28451 | 48 | 71549 | 32732 | 52 | 67268 | 37308 | 55 | 62692 | 18 |
| 43 | 24529 | 45 | 75471 | 28520 | 49 | 71480 | 32806 | 53 | 67194 | 37387 | 56 | 62613 | 17 |
| 44 | 24593 | 46 | 75407 | 28589 | 50 | 71411 | 32880 | 54 | 67120 | 37466 | 57 | 62534 | 16 |
| 45 | 24658 | 47 | 75342 | 28658 | 52 | 71342 | 32954 | 55 | 67046 | 37545 | 59 | 62455 | 15 |
| 46 | 24722 | 49 | 75278 | 28727 | 53 | 71273 | 33028 | 57 | 66972 | 37624 | 60 | 62376 | 14 |
| 47 | 24786 | 50 | 75214 | 28796 | 54 | 71204 | 33102 | 58 | 66898 | 37703 | 61 | 62297 | 13 |
| 48 | 24851 | 51 | 75149 | 28866 | 55 | 71134 | 33177 | 59 | 66823 | 37782 | 63 | 62218 | 12 |
| 49 | 24915 | 52 | 75085 | 28935 | 56 | 71065 | 33251 | 60 | 66749 | 37861 | 64 | 62139 | 11 |
| 50 | 24980 | 53 | 75020 | 29005 | 57 | 70995 | 33325 | 62 | 66675 | 37941 | 65 | 62059 | 10 |
| 51 | 025044 | 54 | 1.974956 | 029074 | 59 | 1.970926 | 033400 | 63 | 1.966600 | 038020 | 67 | 1.961980 | 9 |
| 52 | 25109 | 55 | 74891 | 29144 | 60 | 70856 | 33474 | 64 | 66526 | 38099 | 68 | 61901 | 8 |
| 53 | 25174 | 56 | 74826 | 29214 | 61 | 70786 | 33549 | 65 | 66451 | 38179 | 69 | 61821 | 7 |
| 54 | 25239 | 57 | 74761 | 29283 | 62 | 70717 | 33624 | 66 | 66376 | 38259 | 71 | 61741 | 6 |
| 55 | 25304 | 58 | 74696 | 29353 | 63 | 70647 | 33699 | 68 | 66301 | 38338 | 72 | 61662 | 5 |
| 56 | 25369 | 59 | 74631 | 29423 | 64 | 70577 | 33774 | 69 | 66226 | 38418 | 73 | 61582 | 4 |
| 57 | 25434 | 60 | 74566 | 29493 | 66 | 70507 | 33849 | 70 | 66151 | 38498 | 75 | 61502 | 3 |
| 58 | 25499 | 61 | 74501 | 29564 | 67 | 70436 | 33924 | 72 | 66076 | 38578 | 76 | 61422 | 2 |
| 59 | 25564 | 62 | 74436 | 29634 | 68 | 70366 | 33999 | 73 | 66001 | 38658 | 78 | 61342 | 1 |
| 60 | 025630 | 64 | 1.974370 | 029704 | 69 | 1.970296 | 034074 | 74 | 1.965926 | 038738 | 79 | 1.961262 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 167° | | | 166° | | | 165° | | | 164° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ / ″ Vers. | 16° Versed | Parts for ″ | Suvers. | 17° Versed | Parts for ″ | Suvers. | 18° Versed | Parts for ″ | Suvers. | 19° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 038738 | 0 | 1.961262 | 043695 | 0 | 1.956305 | 048943 | 0 | 1.951057 | 054481 | 0 | 1.945519 | 60 |
| 1 | 38818 | 1 | 61182 | 43780 | 1 | 56220 | 49033 | 2 | 50967 | 54576 | 2 | 45424 | 59 |
| 2 | 38899 | 3 | 61101 | 43865 | 3 | 56135 | 49123 | 3 | 50877 | 54671 | 3 | 45329 | 58 |
| 3 | 38979 | 4 | 61021 | 43951 | 4 | 56049 | 49213 | 5 | 50787 | 54766 | 5 | 45234 | 57 |
| 4 | 39060 | 5 | 60940 | 44036 | 6 | 55964 | 49304 | 6 | 50696 | 54861 | 6 | 45139 | 56 |
| 5 | 39140 | 7 | 60860 | 44121 | 7 | 55879 | 49394 | 8 | 50606 | 54956 | 8 | 45044 | 55 |
| 6 | 39221 | 8 | 60779 | 44207 | 9 | 55793 | 49484 | 9 | 50516 | 55051 | 10 | 44949 | 54 |
| 7 | 39302 | 9 | 60698 | 44293 | 10 | 55707 | 49575 | 11 | 50425 | 55146 | 11 | 44854 | 53 |
| 8 | 39382 | 11 | 60618 | 44378 | 11 | 55622 | 49665 | 12 | 50335 | 55242 | 13 | 44758 | 52 |
| 9 | 39463 | 12 | 60537 | 44464 | 13 | 55536 | 49756 | 14 | 50244 | 55337 | 14 | 44663 | 51 |
| 10 | 39544 | 14 | 60456 | 44550 | 14 | 55450 | 49846 | 15 | 50154 | 55432 | 16 | 44568 | 50 |
| 11 | 039625 | 15 | 1.960375 | 044636 | 16 | 1.955364 | 049937 | 17 | 1.950063 | 055528 | 18 | 1.944472 | 49 |
| 12 | 39706 | 16 | 60294 | 44722 | 17 | 55278 | 50028 | 18 | 49972 | 55624 | 19 | 44376 | 48 |
| 13 | 39787 | 18 | 60213 | 44808 | 19 | 55192 | 50119 | 20 | 49881 | 55719 | 21 | 44281 | 47 |
| 14 | 39869 | 19 | 60131 | 44894 | 20 | 55106 | 50210 | 21 | 49790 | 55815 | 22 | 44185 | 46 |
| 15 | 39950 | 20 | 60050 | 44980 | 22 | 55020 | 50301 | 23 | 49699 | 55911 | 24 | 44089 | 45 |
| 16 | 40032 | 22 | 59968 | 45066 | 23 | 54934 | 50392 | 24 | 49608 | 56007 | 26 | 43993 | 44 |
| 17 | 40113 | 23 | 59887 | 45153 | 24 | 54847 | 50483 | 26 | 49517 | 56103 | 27 | 43897 | 43 |
| 18 | 40195 | 24 | 59805 | 45239 | 26 | 54761 | 50574 | 27 | 49426 | 56199 | 29 | 43801 | 42 |
| 19 | 40276 | 26 | 59724 | 45326 | 27 | 54674 | 50666 | 29 | 49334 | 56295 | 30 | 43705 | 41 |
| 20 | 40358 | 27 | 59642 | 45412 | 29 | 54588 | 50757 | 30 | 49243 | 56391 | 32 | 43609 | 40 |
| 21 | 040440 | 28 | 1.959560 | 045499 | 30 | 1.954501 | 050849 | 32 | 1.949151 | 056488 | 34 | 1.943512 | 39 |
| 22 | 40522 | 30 | 59478 | 45586 | 32 | 54414 | 50940 | 33 | 49060 | 56584 | 35 | 43416 | 38 |
| 23 | 40604 | 31 | 59396 | 45673 | 33 | 54327 | 51032 | 35 | 48968 | 56681 | 37 | 43319 | 37 |
| 24 | 40686 | 32 | 59314 | 45760 | 35 | 54240 | 51124 | 36 | 48876 | 56777 | 38 | 43223 | 36 |
| 25 | 40768 | 34 | 59232 | 45847 | 36 | 54153 | 51216 | 38 | 48784 | 56874 | 40 | 43126 | 35 |
| 26 | 40850 | 35 | 59150 | 45934 | 37 | 54066 | 51308 | 39 | 48692 | 56971 | 42 | 43029 | 34 |
| 27 | 40933 | 36 | 59067 | 46021 | 39 | 53979 | 51400 | 41 | 48600 | 57068 | 43 | 42932 | 33 |
| 28 | 41015 | 38 | 58985 | 46108 | 40 | 53892 | 51492 | 42 | 48508 | 57164 | 45 | 42836 | 32 |
| 29 | 41098 | 39 | 58902 | 46196 | 42 | 53804 | 51584 | 44 | 48416 | 57261 | 47 | 42739 | 31 |
| 30 | 41180 | 41 | 58820 | 46283 | 44 | 53717 | 51676 | 46 | 48324 | 57358 | 48 | 42642 | 30 |
| 31 | 041263 | 43 | 1.958737 | 046371 | 45 | 1.953629 | 051769 | 48 | 1.948231 | 057456 | 51 | 1.942544 | 29 |
| 32 | 41346 | 44 | 58654 | 46458 | 47 | 53542 | 51861 | 50 | 48139 | 57553 | 52 | 42447 | 28 |
| 33 | 41428 | 46 | 58572 | 46546 | 48 | 53454 | 51954 | 51 | 48046 | 57650 | 54 | 42350 | 27 |
| 34 | 41511 | 47 | 58489 | 46634 | 50 | 53366 | 52046 | 53 | 47954 | 57747 | 56 | 42253 | 26 |
| 35 | 41594 | 49 | 58406 | 46721 | 51 | 53279 | 52139 | 54 | 47861 | 57845 | 57 | 42155 | 25 |
| 36 | 41677 | 50 | 58323 | 46809 | 53 | 53191 | 52232 | 56 | 47768 | 57942 | 59 | 42058 | 24 |
| 37 | 41761 | 51 | 58239 | 46897 | 55 | 53103 | 52324 | 57 | 47676 | 58040 | 60 | 41960 | 23 |
| 38 | 41844 | 53 | 58156 | 46985 | 56 | 53015 | 52417 | 59 | 47583 | 58138 | 62 | 41862 | 22 |
| 39 | 41927 | 54 | 58073 | 47074 | 58 | 52926 | 52510 | 61 | 47490 | 58236 | 64 | 41764 | 21 |
| 40 | 42010 | 55 | 57990 | 47162 | 59 | 52838 | 52603 | 62 | 47397 | 58333 | 66 | 41667 | 20 |
| 41 | 042094 | 57 | 1.957906 | 047250 | 61 | 1.952750 | 052696 | 64 | 1.947304 | 058431 | 67 | 1.941569 | 19 |
| 42 | 42177 | 58 | 57823 | 47338 | 62 | 52662 | 52790 | 65 | 47210 | 58529 | 69 | 41471 | 18 |
| 43 | 42261 | 59 | 57739 | 47427 | 64 | 52573 | 52883 | 67 | 47117 | 58628 | 71 | 41372 | 17 |
| 44 | 42345 | 61 | 57655 | 47516 | 65 | 52484 | 52976 | 68 | 47024 | 58726 | 72 | 41274 | 16 |
| 45 | 42429 | 62 | 57571 | 47604 | 67 | 52396 | 53070 | 70 | 46930 | 58824 | 74 | 41176 | 15 |
| 46 | 42512 | 64 | 57488 | 47693 | 68 | 52307 | 53163 | 71 | 46837 | 58922 | 75 | 41078 | 14 |
| 47 | 42596 | 65 | 57404 | 47782 | 70 | 52218 | 53257 | 73 | 46743 | 59021 | 77 | 40979 | 13 |
| 48 | 42680 | 66 | 57320 | 47871 | 71 | 52129 | 53351 | 75 | 46649 | 59119 | 79 | 40881 | 12 |
| 49 | 42765 | 68 | 57235 | 47960 | 73 | 52040 | 53444 | 76 | 46556 | 59218 | 80 | 40782 | 11 |
| 50 | 42849 | 69 | 57151 | 48049 | 74 | 51951 | 53538 | 78 | 46462 | 59316 | 82 | 40684 | 10 |
| 51 | 042933 | 71 | 1.957067 | 048138 | 76 | 1.951862 | 053632 | 79 | 1.946368 | 059415 | 84 | 1.940585 | 9 |
| 52 | 43017 | 72 | 56983 | 48227 | 77 | 51773 | 53726 | 81 | 46274 | 59514 | 85 | 40486 | 8 |
| 53 | 43102 | 74 | 56898 | 48316 | 79 | 51684 | 53820 | 82 | 46180 | 59613 | 87 | 40387 | 7 |
| 54 | 43186 | 75 | 56814 | 48406 | 80 | 51594 | 53915 | 84 | 46085 | 59712 | 89 | 40288 | 6 |
| 55 | 43271 | 77 | 56729 | 48495 | 82 | 51505 | 54009 | 85 | 45991 | 59811 | 90 | 40189 | 5 |
| 56 | 43356 | 78 | 56644 | 48585 | 83 | 51415 | 54103 | 87 | 45897 | 59910 | 92 | 40090 | 4 |
| 57 | 43440 | 80 | 56560 | 48674 | 85 | 51326 | 54198 | 88 | 45802 | 60009 | 94 | 39991 | 3 |
| 58 | 43525 | 81 | 56475 | 48764 | 86 | 51236 | 54292 | 90 | 45708 | 60109 | 95 | 39891 | 2 |
| 59 | 43610 | 82 | 56390 | 48854 | 88 | 51146 | 54387 | 92 | 45613 | 60208 | 97 | 39792 | 1 |
| 60 | 043695 | 83 | 1.956305 | 048943 | 89 | 1.951057 | 054481 | 93 | 1.945519 | 060307 | 98 | 1.939693 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | ′ ″ Suv. |
| | 163° | | | 162° | | | 161° | | | 160° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 20° Versed. | Parts for ″ | 20° Suvers. | 21° Versed. | Parts for ″ | 21° Suvers. | 22° Versed. | Parts for ″ | 22° Suvers. | 23° Versed. | Parts for ″ | 23° Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 060307 | 0 | 1.939693 | 066420 | 0 | 1.933580 | 072816 | 0 | 1.927184 | 079495 | 0 | 1.920505 | 60 |
| 1 | 60407 | 2 | 39593 | 66524 | 2 | 33476 | 72925 | 2 | 27075 | 79609 | 2 | 20391 | 59 |
| 2 | 60506 | 3 | 39494 | 66628 | 4 | 33372 | 73034 | 4 | 26966 | 79723 | 4 | 20277 | 58 |
| 3 | 60606 | 5 | 39394 | 66733 | 5 | 33267 | 73143 | 5 | 26857 | 79836 | 6 | 20164 | 57 |
| 4 | 60706 | 7 | 39294 | 66837 | 7 | 33163 | 73253 | 7 | 26747 | 79950 | 8 | 20050 | 56 |
| 5 | 60806 | 8 | 39194 | 66942 | 9 | 33058 | 73362 | 9 | 26638 | 80064 | 10 | 19936 | 55 |
| 6 | 60906 | 10 | 39094 | 67046 | 11 | 32954 | 73471 | 11 | 26529 | 80178 | 11 | 19822 | 54 |
| 7 | 61006 | 12 | 38994 | 67151 | 12 | 32849 | 73581 | 13 | 26419 | 80293 | 13 | 19707 | 53 |
| 8 | 61106 | 13 | 38894 | 67256 | 14 | 32744 | 73690 | 15 | 26310 | 80407 | 15 | 19593 | 52 |
| 9 | 61206 | 15 | 38794 | 67361 | 16 | 32639 | 73800 | 17 | 26200 | 80521 | 17 | 19479 | 51 |
| 10 | 61306 | 17 | 38694 | 67466 | 18 | 32534 | 73910 | 18 | 26090 | 80636 | 19 | 19364 | 50 |
| 11 | 061407 | 18 | 1.938593 | 067571 | 19 | 1.932429 | 074019 | 20 | 1.925981 | 080750 | 21 | 1.919250 | 49 |
| 12 | 61507 | 20 | 38493 | 67676 | 21 | 32324 | 74129 | 22 | 25871 | 80865 | 23 | 19135 | 48 |
| 13 | 61607 | 22 | 38393 | 67781 | 23 | 32219 | 74239 | 24 | 25761 | 80979 | 25 | 19021 | 47 |
| 14 | 61708 | 23 | 38292 | 67887 | 25 | 32113 | 74349 | 26 | 25651 | 81094 | 27 | 18906 | 46 |
| 15 | 61809 | 25 | 38191 | 67992 | 26 | 32008 | 74459 | 28 | 25541 | 81209 | 29 | 18791 | 45 |
| 16 | 61909 | 27 | 38091 | 68098 | 28 | 31902 | 74570 | 29 | 25430 | 81324 | 31 | 18676 | 44 |
| 17 | 62010 | 28 | 37990 | 68203 | 30 | 31797 | 74680 | 31 | 25320 | 81439 | 33 | 18561 | 43 |
| 18 | 62111 | 30 | 37889 | 68309 | 32 | 31691 | 74790 | 33 | 25210 | 81554 | 35 | 18446 | 42 |
| 19 | 62212 | 32 | 37788 | 68414 | 33 | 31586 | 74901 | 35 | 25099 | 81669 | 37 | 18331 | 41 |
| 20 | 62313 | 34 | 37687 | 68520 | 35 | 31480 | 75011 | 37 | 24989 | 81784 | 38 | 18216 | 40 |
| 21 | 062414 | 35 | 1.937586 | 068626 | 37 | 1.931374 | 075122 | 39 | 1.924878 | 081899 | 40 | 1.918101 | 39 |
| 22 | 62515 | 37 | 37485 | 68732 | 39 | 31268 | 75232 | 40 | 24768 | 82014 | 42 | 17986 | 38 |
| 23 | 62617 | 39 | 37383 | 68838 | 40 | 31162 | 75343 | 42 | 24657 | 82130 | 44 | 17870 | 37 |
| 24 | 62718 | 40 | 37282 | 68944 | 42 | 31056 | 75454 | 44 | 24546 | 82245 | 46 | 17755 | 36 |
| 25 | 62819 | 42 | 37181 | 69050 | 44 | 30950 | 75565 | 46 | 24435 | 82361 | 48 | 17639 | 35 |
| 26 | 62921 | 44 | 37079 | 69157 | 46 | 30843 | 75676 | 48 | 24324 | 82477 | 50 | 17523 | 34 |
| 27 | 63023 | 46 | 36977 | 69263 | 48 | 30737 | 75787 | 50 | 24213 | 82592 | 52 | 17408 | 33 |
| 28 | 63124 | 47 | 36876 | 69369 | 50 | 30631 | 75898 | 52 | 24102 | 82708 | 54 | 17292 | 32 |
| 29 | 63226 | 49 | 36774 | 69476 | 52 | 30524 | 76009 | 54 | 23991 | 82824 | 56 | 17176 | 31 |
| 30 | 63328 | 51 | 36672 | 69582 | 53 | 30418 | 76120 | 56 | 23880 | 82940 | 58 | 17060 | 30 |
| 31 | 063430 | 53 | 1.936570 | 069689 | 55 | 1.930311 | 076232 | 58 | 1.923768 | 083056 | 60 | 1.916944 | 29 |
| 32 | 63532 | 55 | 36468 | 69796 | 57 | 30204 | 76343 | 60 | 23657 | 83172 | 62 | 16828 | 28 |
| 33 | 63634 | 57 | 36366 | 69903 | 59 | 30097 | 76455 | 62 | 23545 | 83288 | 64 | 16712 | 27 |
| 34 | 63736 | 58 | 36264 | 70009 | 61 | 29991 | 76566 | 64 | 23434 | 83404 | 66 | 16596 | 26 |
| 35 | 63838 | 60 | 36162 | 70116 | 63 | 29884 | 76678 | 65 | 23322 | 83521 | 68 | 16479 | 25 |
| 36 | 63940 | 62 | 36060 | 70223 | 65 | 29777 | 76790 | 67 | 23210 | 83637 | 70 | 16363 | 24 |
| 37 | 64043 | 63 | 35957 | 70331 | 67 | 29669 | 76902 | 69 | 23098 | 83754 | 72 | 16246 | 23 |
| 38 | 64145 | 65 | 35855 | 70438 | 69 | 29562 | 77013 | 71 | 22987 | 83870 | 74 | 16130 | 22 |
| 39 | 64248 | 67 | 35752 | 70545 | 71 | 29455 | 77125 | 73 | 22875 | 83987 | 76 | 16013 | 21 |
| 40 | 64350 | 69 | 35650 | 70652 | 72 | 29348 | 77238 | 75 | 22762 | 84104 | 78 | 15896 | 20 |
| 41 | 064453 | 70 | 1.935547 | 070760 | 74 | 1.929240 | 077350 | 77 | 1.922650 | 084220 | 80 | 1.915780 | 19 |
| 42 | 64556 | 72 | 35444 | 70867 | 76 | 29133 | 77462 | 79 | 22538 | 84337 | 82 | 15663 | 18 |
| 43 | 64659 | 74 | 35341 | 70975 | 78 | 29025 | 77574 | 81 | 22426 | 84454 | 84 | 15546 | 17 |
| 44 | 64762 | 75 | 35238 | 71083 | 80 | 28917 | 77687 | 83 | 22313 | 84571 | 86 | 15429 | 16 |
| 45 | 64865 | 77 | 35135 | 71190 | 81 | 28810 | 77799 | 84 | 22201 | 84688 | 88 | 15312 | 15 |
| 46 | 64968 | 79 | 35032 | 71298 | 83 | 28702 | 77912 | 86 | 22088 | 84806 | 90 | 15194 | 14 |
| 47 | 65071 | 81 | 34929 | 71406 | 85 | 28594 | 78024 | 88 | 21976 | 84923 | 92 | 15077 | 13 |
| 48 | 65174 | 82 | 34826 | 71514 | 87 | 28486 | 78137 | 90 | 21863 | 85040 | 94 | 14960 | 12 |
| 49 | 65278 | 84 | 34722 | 71622 | 89 | 28378 | 78250 | 92 | 21750 | 85158 | 96 | 14842 | 11 |
| 50 | 65381 | 86 | 34619 | 71730 | 90 | 28270 | 78362 | 94 | 21638 | 85275 | 98 | 14725 | 10 |
| 51 | 065485 | 87 | 1.934515 | 071839 | 92 | 1.928161 | 078475 | 96 | 1.921525 | 085393 | 100 | 1.914607 | 9 |
| 52 | 65588 | 89 | 34412 | 71947 | 94 | 28053 | 78588 | 98 | 21412 | 85510 | 102 | 14490 | 8 |
| 53 | 65692 | 91 | 34308 | 72055 | 96 | 27945 | 78701 | 100 | 21299 | 85628 | 104 | 14372 | 7 |
| 54 | 65795 | 93 | 34205 | 72164 | 98 | 27836 | 78815 | 101 | 21185 | 85746 | 106 | 14254 | 6 |
| 55 | 65899 | 95 | 34101 | 72272 | 100 | 27728 | 78928 | 103 | 21072 | 85864 | 108 | 14136 | 5 |
| 56 | 66003 | 96 | 33997 | 72381 | 101 | 27619 | 79041 | 105 | 20959 | 85982 | 110 | 14018 | 4 |
| 57 | 66107 | 98 | 33893 | 72490 | 103 | 27510 | 79154 | 107 | 20846 | 86100 | 112 | 13900 | 3 |
| 58 | 66211 | 100 | 33789 | 72598 | 105 | 27402 | 79268 | 109 | 20732 | 86218 | 114 | 13782 | 2 |
| 59 | 66315 | 101 | 33685 | 72707 | 107 | 27293 | 79381 | 110 | 20619 | 86336 | 116 | 13664 | 1 |
| 60 | 066420 | 103 | 1.933580 | 072816 | 109 | 1.927184 | 079495 | 112 | 1.920505 | 086454 | 118 | 1.913546 | 0 |
| ″ Vers. | 159° Suvers. | Parts for ″ | 159° Versed. | 158° Suvers. | Parts for ″ | 158° Versed. | 157° Suvers. | Parts for ″ | 157° Versed. | 156° Suvers. | Parts for ″ | 156° Versed. | ′ ″ Suv. |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 24° Versed. | Parts for ″ | Suvers. | 25° Versed. | Parts for ″ | Suvers. | 26° Versed. | Parts for ″ | Suvers. | 27° Versed. | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 086454 | 0 | 1.913546 | 093692 | 0 | 1.906308 | 101206 | 0 | 1.898794 | 108993 | 0 | 1.891007 | 60 |
| 1 | 86573 | 2 | 13427 | 93815 | 2 | 06185 | 01333 | 2 | 98667 | 09126 | 2 | 90874 | 59 |
| 2 | 86691 | 4 | 13309 | 93938 | 4 | 06062 | 01461 | 4 | 98539 | 09258 | 4 | 90742 | 58 |
| 3 | 86810 | 6 | 13190 | 94061 | 6 | 05939 | 01589 | 6 | 98411 | 09390 | 6 | 90610 | 57 |
| 4 | 86928 | 8 | 13072 | 94185 | 8 | 05815 | 01717 | 8 | 98283 | 09522 | 8 | 90478 | 56 |
| 5 | 87047 | 10 | 12953 | 94308 | 10 | 05692 | 01844 | 11 | 98156 | 09655 | 11 | 90345 | 55 |
| 6 | 87166 | 12 | 12834 | 94431 | 12 | 05569 | 01972 | 13 | 98028 | 09787 | 13 | 90213 | 54 |
| 7 | 87285 | 14 | 12715 | 94555 | 14 | 05445 | 02100 | 15 | 97900 | 09920 | 15 | 90080 | 53 |
| 8 | 87403 | 16 | 12597 | 94678 | 16 | 05322 | 02228 | 17 | 97772 | 10052 | 17 | 89948 | 52 |
| 9 | 87522 | 18 | 12478 | 94802 | 18 | 05198 | 02357 | 19 | 97643 | 10185 | 19 | 89815 | 51 |
| 10 | 87642 | 20 | 12358 | 94925 | 21 | 05075 | 02485 | 21 | 97515 | 10318 | 21 | 89682 | 50 |
| 11 | 087761 | 22 | 1.912239 | 095049 | 23 | 1.904951 | 102613 | 23 | 1.897387 | 110451 | 23 | 1.889549 | 49 |
| 12 | 87880 | 24 | 12120 | 95173 | 25 | 04827 | 02742 | 26 | 97258 | 10584 | 26 | 89416 | 48 |
| 13 | 87999 | 26 | 12001 | 95297 | 27 | 04703 | 02870 | 28 | 97130 | 10717 | 28 | 89283 | 47 |
| 14 | 88118 | 28 | 11882 | 95421 | 29 | 04579 | 02999 | 30 | 97001 | 10850 | 30 | 89150 | 46 |
| 15 | 88238 | 30 | 11762 | 95545 | 31 | 04455 | 03127 | 32 | 96873 | 10983 | 32 | 89017 | 45 |
| 16 | 88357 | 32 | 11643 | 95669 | 33 | 04331 | 03256 | 34 | 96744 | 11116 | 35 | 88884 | 44 |
| 17 | 88477 | 34 | 11523 | 95793 | 35 | 04207 | 03385 | 36 | 96615 | 11249 | 37 | 88751 | 43 |
| 18 | 88597 | 36 | 11403 | 95917 | 37 | 04083 | 03514 | 38 | 96486 | 11383 | 39 | 88617 | 42 |
| 19 | 88716 | 38 | 11284 | 96042 | 39 | 03958 | 03642 | 40 | 96358 | 11516 | 41 | 88484 | 41 |
| 20 | 88836 | 40 | 11164 | 96166 | 41 | 03834 | 03771 | 43 | 96229 | 11650 | 44 | 88350 | 40 |
| 21 | 088956 | 42 | 1.911044 | 096291 | 43 | 1.903709 | 103901 | 45 | 1.896099 | 111783 | 46 | 1.888217 | 39 |
| 22 | 89076 | 44 | 10924 | 96415 | 45 | 03585 | 04030 | 47 | 95970 | 11917 | 48 | 88083 | 38 |
| 23 | 89196 | 46 | 10804 | 96540 | 47 | 03460 | 04159 | 49 | 95841 | 12051 | 50 | 87949 | 37 |
| 24 | 89316 | 48 | 10684 | 96665 | 49 | 03335 | 04288 | 52 | 95712 | 12185 | 52 | 87815 | 36 |
| 25 | 89436 | 50 | 10564 | 96789 | 51 | 03211 | 04418 | 54 | 95582 | 12318 | 55 | 87682 | 35 |
| 26 | 89557 | 52 | 10443 | 90914 | 54 | 03086 | 04547 | 57 | 95453 | 12452 | 58 | 87548 | 34 |
| 27 | 89677 | 54 | 10323 | 97039 | 56 | 02961 | 04677 | 58 | 95323 | 12587 | 60 | 87413 | 33 |
| 28 | 89798 | 56 | 10202 | 97164 | 58 | 02836 | 04806 | 60 | 95194 | 12721 | 62 | 87279 | 32 |
| 29 | 89918 | 58 | 10082 | 97289 | 60 | 02711 | 04936 | 62 | 95064 | 12855 | 64 | 87145 | 31 |
| 30 | 90039 | 60 | 09961 | 97415 | 63 | 02585 | 05066 | 65 | 94934 | 12989 | 67 | 87011 | 30 |
| 31 | 090159 | 62 | 1.909841 | 097540 | 65 | 1.902460 | 105195 | 67 | 1.894805 | 113123 | 69 | 1.886877 | 29 |
| 32 | 90280 | 64 | 09720 | 97665 | 67 | 02335 | 05325 | 69 | 94675 | 13258 | 71 | 86742 | 28 |
| 33 | 90401 | 66 | 09599 | 97791 | 69 | 02209 | 05455 | 71 | 94545 | 13392 | 74 | 86608 | 27 |
| 34 | 90522 | 68 | 09478 | 97916 | 71 | 02084 | 05585 | 73 | 94415 | 13527 | 76 | 86473 | 26 |
| 35 | 90643 | 70 | 09357 | 98042 | 73 | 01958 | 05716 | 75 | 94284 | 13662 | 78 | 86338 | 25 |
| 36 | 90764 | 72 | 09236 | 98167 | 75 | 01833 | 05846 | 78 | 94154 | 13796 | 81 | 86204 | 24 |
| 37 | 90885 | 74 | 09115 | 98293 | 77 | 01707 | 05976 | 80 | 94024 | 13931 | 83 | 86069 | 23 |
| 38 | 91006 | 76 | 08994 | 98419 | 79 | 01581 | 06106 | 82 | 93894 | 14066 | 85 | 85934 | 22 |
| 39 | 91127 | 78 | 08873 | 98545 | 81 | 01455 | 06237 | 84 | 93763 | 14201 | 87 | 85799 | 21 |
| 40 | 91249 | 80 | 08751 | 98671 | 84 | 01329 | 06367 | 86 | 93633 | 14336 | 90 | 85664 | 20 |
| 41 | 091370 | 82 | 1.908630 | 098797 | 86 | 1.901203 | 106498 | 89 | 1.893502 | 114471 | 92 | 1.885529 | 19 |
| 42 | 91492 | 84 | 08508 | 98923 | 88 | 01077 | 06629 | 91 | 93371 | 14606 | 94 | 85394 | 18 |
| 43 | 91613 | 86 | 08387 | 99049 | 90 | 00951 | 06759 | 93 | 93241 | 14742 | 96 | 85258 | 17 |
| 44 | 91735 | 88 | 08265 | 99175 | 92 | 00825 | 06890 | 95 | 93110 | 14877 | 98 | 85123 | 16 |
| 45 | 91857 | 90 | 08143 | 99302 | 95 | 00698 | 07021 | 97 | 92979 | 15012 | 101 | 84988 | 15 |
| 46 | 91979 | 92 | 08021 | 99428 | 97 | 00572 | 07152 | 100 | 92848 | 15148 | 103 | 84852 | 14 |
| 47 | 92100 | 94 | 07900 | 99555 | 99 | 00445 | 07283 | 102 | 92717 | 15283 | 105 | 84717 | 13 |
| 48 | 92222 | 96 | 07778 | 99681 | 101 | 00319 | 07414 | 104 | 92586 | 15419 | 107 | 84581 | 12 |
| 49 | 92345 | 98 | 07655 | 99808 | 103 | 00192 | 07545 | 106 | 92455 | 15555 | 110 | 84445 | 11 |
| 50 | 92467 | 100 | 07533 | 099935 | 105 | 1.900065 | 07677 | 108 | 92323 | 15690 | 112 | 84310 | 10 |
| 51 | 092589 | 102 | 1.907411 | 100061 | 107 | 1.899939 | 107808 | 111 | 1.892192 | 115826 | 114 | 1.884174 | 9 |
| 52 | 92711 | 104 | 07289 | 00188 | 109 | 99812 | 07939 | 113 | 92061 | 15962 | 116 | 84038 | 8 |
| 53 | 92833 | 106 | 07167 | 00315 | 111 | 99685 | 08071 | 115 | 91929 | 16098 | 119 | 83902 | 7 |
| 54 | 92956 | 109 | 07044 | 00442 | 113 | 99558 | 08202 | 117 | 91798 | 16234 | 121 | 83766 | 6 |
| 55 | 93078 | 111 | 06922 | 00569 | 116 | 99431 | 08334 | 119 | 91666 | 16370 | 124 | 83630 | 5 |
| 56 | 93201 | 113 | 06799 | 00696 | 118 | 99304 | 08466 | 122 | 91534 | 16507 | 126 | 83493 | 4 |
| 57 | 93324 | 115 | 06676 | 00824 | 120 | 99176 | 08598 | 124 | 91402 | 16643 | 129 | 83357 | 3 |
| 58 | 93446 | 117 | 06554 | 00951 | 122 | 99049 | 08729 | 126 | 91271 | 16779 | 131 | 83221 | 2 |
| 59 | 93569 | 119 | 06431 | 01078 | 124 | 98922 | 08861 | 129 | 91139 | 16916 | 133 | 83084 | 1 |
| 60 | 093692 | 121 | 1.906308 | 101206 | 127 | 1.898794 | 108993 | 131 | 1.891007 | 117052 | 136 | 1.882948 | 0 |
| ″ Vers. | 155° Suvers. | Parts for ″ | Versed. | 154° Suvers. | Parts for ″ | Versed. | 153° Suvers. | Parts for ″ | Versed. | 152° Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 28° Versed | Parts for ″ | Suvers. | 29° Versed | Parts for ″ | Suvers. | 30° Versed | Parts for ″ | Suvers. | 31° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 117052 | 0 | 1.882948 | 125380 | 0 | 1.874620 | 133975 | 0 | 1.866025 | 142833 | 0 | 1.857167 | 60 |
| 1 | 17189 | 2 | 82811 | 25521 | 2 | 74479 | 34120 | 2 | 65880 | 42983 | 3 | 57017 | 59 |
| 2 | 17326 | 4 | 82674 | 25662 | 5 | 74338 | 34266 | 5 | 65734 | 43132 | 5 | 56868 | 58 |
| 3 | 17462 | 6 | 82538 | 25804 | 7 | 74196 | 34411 | 7 | 65589 | 43282 | 8 | 56718 | 57 |
| 4 | 17599 | 9 | 82401 | 25945 | 9 | 74055 | 34557 | 9 | 65443 | 43433 | 10 | 56567 | 56 |
| 5 | 17736 | 11 | 82264 | 26086 | 12 | 73914 | 34703 | 12 | 65297 | 43583 | 13 | 56417 | 55 |
| 6 | 17873 | 13 | 82127 | 26228 | 14 | 73772 | 34849 | 15 | 65151 | 43733 | 15 | 56267 | 54 |
| 7 | 18010 | 16 | 81990 | 26369 | 16 | 73631 | 34994 | 17 | 65006 | 43883 | 17 | 56117 | 53 |
| 8 | 18147 | 18 | 81853 | 26511 | 19 | 73489 | 35140 | 19 | 64860 | 44034 | 20 | 55966 | 52 |
| 9 | 18284 | 21 | 81716 | 26652 | 21 | 73348 | 35287 | 22 | 64713 | 44184 | 22 | 55816 | 51 |
| 10 | 18422 | 23 | 81578 | 26794 | 24 | 73206 | 35433 | 24 | 64567 | 44334 | 25 | 55666 | 50 |
| 11 | 118559 | 25 | 1.881441 | 126936 | 26 | 1.873064 | 135579 | 27 | 1.864421 | 144485 | 27 | 1.855515 | 49 |
| 12 | 18696 | 27 | 81304 | 27078 | 29 | 72922 | 35725 | 29 | 64275 | 44636 | 30 | 55364 | 48 |
| 13 | 18834 | 30 | 81166 | 27220 | 31 | 72780 | 35872 | 32 | 64128 | 44786 | 32 | 55214 | 47 |
| 14 | 18972 | 32 | 81028 | 27362 | 33 | 72638 | 36018 | 34 | 63982 | 44937 | 35 | 55063 | 46 |
| 15 | 19109 | 34 | 80891 | 27504 | 36 | 72496 | 36164 | 37 | 63836 | 45088 | 38 | 54912 | 45 |
| 16 | 19247 | 37 | 80753 | 27646 | 38 | 72354 | 36311 | 39 | 63689 | 45239 | 40 | 54761 | 44 |
| 17 | 19385 | 39 | 80615 | 27788 | 40 | 72212 | 36458 | 41 | 63542 | 45390 | 43 | 54610 | 43 |
| 18 | 19523 | 41 | 80477 | 27931 | 43 | 72069 | 36604 | 44 | 63396 | 45541 | 45 | 54459 | 42 |
| 19 | 19661 | 43 | 80339 | 28073 | 45 | 71927 | 36751 | 46 | 63249 | 45692 | 47 | 54308 | 41 |
| 20 | 19799 | 46 | 80201 | 28216 | 47 | 71784 | 36898 | 49 | 63102 | 45844 | 50 | 54156 | 40 |
| 21 | 119937 | 48 | 1.880063 | 128358 | 49 | 1.871642 | 137045 | 51 | 1.862955 | 145995 | 52 | 1.854005 | 39 |
| 22 | 20075 | 52 | 79925 | 28501 | 52 | 71499 | 37192 | 54 | 62808 | 46146 | 55 | 53854 | 38 |
| 23 | 20213 | 54 | 79787 | 28643 | 54 | 71357 | 37339 | 56 | 62661 | 46298 | 57 | 53702 | 37 |
| 24 | 20351 | 56 | 79649 | 28786 | 56 | 71214 | 37486 | 59 | 62514 | 46449 | 60 | 53551 | 36 |
| 25 | 20490 | 58 | 79510 | 28929 | 59 | 71071 | 37634 | 61 | 62366 | 46601 | 62 | 53399 | 35 |
| 26 | 20628 | 60 | 79372 | 29072 | 61 | 70928 | 37781 | 63 | 62219 | 46752 | 65 | 53248 | 34 |
| 27 | 20767 | 62 | 79233 | 29215 | 64 | 70785 | 37928 | 66 | 62072 | 46904 | 67 | 53096 | 33 |
| 28 | 20905 | 64 | 79095 | 29358 | 66 | 70642 | 38076 | 68 | 61924 | 47056 | 70 | 52944 | 32 |
| 29 | 21044 | 67 | 78956 | 29501 | 69 | 70499 | 38223 | 71 | 61777 | 47208 | 73 | 52792 | 31 |
| 30 | 21183 | 69 | 78817 | 29644 | 71 | 70356 | 38371 | 74 | 61629 | 47360 | 76 | 52640 | 30 |
| 31 | 121322 | 71 | 1.878678 | 129788 | 74 | 1.870212 | 138518 | 77 | 1.861482 | 147512 | 78 | 1.852488 | 29 |
| 32 | 21461 | 73 | 78539 | 29931 | 77 | 70069 | 38666 | 80 | 61334 | 47664 | 81 | 52336 | 28 |
| 33 | 21600 | 76 | 78400 | 30074 | 79 | 69926 | 38814 | 82 | 61186 | 47816 | 83 | 52184 | 27 |
| 34 | 21739 | 78 | 78261 | 30218 | 82 | 69782 | 38962 | 84 | 61038 | 47968 | 85 | 52032 | 26 |
| 35 | 21878 | 81 | 78122 | 30361 | 84 | 69639 | 39110 | 87 | 60890 | 48121 | 88 | 51879 | 25 |
| 36 | 22017 | 84 | 77983 | 30505 | 87 | 69495 | 39258 | 89 | 60742 | 48273 | 90 | 51727 | 24 |
| 37 | 22156 | 86 | 77844 | 30649 | 89 | 69351 | 39406 | 92 | 60594 | 48425 | 93 | 51575 | 23 |
| 38 | 22296 | 89 | 77704 | 30793 | 91 | 69207 | 39554 | 94 | 60446 | 48578 | 96 | 51422 | 22 |
| 39 | 22435 | 91 | 77565 | 30936 | 94 | 69064 | 39702 | 97 | 60298 | 48731 | 99 | 51269 | 21 |
| 40 | 22575 | 93 | 77425 | 31080 | 96 | 68920 | 39851 | 99 | 60149 | 48883 | 102 | 51117 | 20 |
| 41 | 122714 | 95 | 1.877286 | 131224 | 98 | 1.868776 | 139999 | 102 | 1.860001 | 149036 | 105 | 1.850964 | 19 |
| 42 | 22854 | 97 | 77146 | 31368 | 101 | 68632 | 40148 | 103 | 59852 | 49189 | 107 | 50811 | 18 |
| 43 | 22994 | 100 | 77006 | 31513 | 103 | 68487 | 40296 | 106 | 59704 | 49342 | 109 | 50658 | 17 |
| 44 | 23133 | 102 | 76867 | 31657 | 105 | 68343 | 40445 | 109 | 59555 | 49495 | 111 | 50505 | 16 |
| 45 | 23273 | 105 | 76727 | 31801 | 108 | 68199 | 40594 | 112 | 59406 | 49648 | 114 | 50352 | 15 |
| 46 | 23413 | 107 | 76587 | 31946 | 110 | 68054 | 40742 | 114 | 59258 | 49801 | 117 | 50199 | 14 |
| 47 | 23553 | 109 | 76447 | 32090 | 112 | 67910 | 40891 | 116 | 59109 | 49954 | 119 | 50046 | 13 |
| 48 | 23693 | 112 | 76307 | 32234 | 115 | 67766 | 41040 | 118 | 58960 | 50107 | 122 | 49893 | 12 |
| 49 | 23833 | 114 | 76167 | 32379 | 117 | 67621 | 41189 | 121 | 58811 | 50261 | 125 | 49739 | 11 |
| 50 | 23974 | 117 | 76026 | 32524 | 119 | 67476 | 41338 | 124 | 58662 | 50414 | 128 | 49586 | 10 |
| 51 | 124114 | 119 | 1.875886 | 132669 | 122 | 1.867331 | 141487 | 126 | 1.858513 | 150567 | 131 | 1.849433 | 9 |
| 52 | 24254 | 122 | 75746 | 32813 | 124 | 67187 | 41636 | 129 | 58364 | 50721 | 133 | 49279 | 8 |
| 53 | 24395 | 124 | 75605 | 32958 | 127 | 67042 | 41786 | 131 | 58214 | 50875 | 135 | 49125 | 7 |
| 54 | 24535 | 126 | 75465 | 33103 | 129 | 66897 | 41935 | 134 | 58065 | 51028 | 138 | 48972 | 6 |
| 55 | 24676 | 129 | 75324 | 33248 | 132 | 66752 | 42084 | 136 | 57916 | 51182 | 140 | 48818 | 5 |
| 56 | 24817 | 131 | 75183 | 33393 | 134 | 66607 | 42234 | 139 | 57766 | 51336 | 143 | 48664 | 4 |
| 57 | 24958 | 133 | 75042 | 33539 | 137 | 66461 | 42384 | 142 | 57616 | 51490 | 145 | 48510 | 3 |
| 58 | 25098 | 136 | 74902 | 33684 | 139 | 66316 | 42533 | 145 | 57467 | 51644 | 148 | 48356 | 2 |
| 59 | 25239 | 138 | 74761 | 33829 | 142 | 66171 | 42683 | 147 | 57317 | 51798 | 151 | 48202 | 1 |
| 60 | 125380 | 140 | 1.874620 | 133975 | 144 | 1.866025 | 142833 | 149 | 1.857167 | 151952 | 153 | 1.848048 | 0 |
| ″ Vers. | 151° Suvers. | Parts for ″ | Versed. | 150° Suvers. | Parts for ″ | Versed. | 149° Suvers. | Parts for ″ | Versed. | 148° Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ | 32° | | | 33° | | | 34° | | | 35° | | | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ″ Vers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | ″ Suv. |
| 0 | 151952 | 0 | 1.848048 | 161329 | 0 | 1.838671 | 170962 | 0 | 1.829038 | 180848 | 0 | 1.819152 | 60 |
| 1 | 52106 | 3 | 47894 | 61488 | 3 | 38512 | 71125 | 3 | 28875 | 81015 | 3 | 18985 | 59 |
| 2 | 52260 | 5 | 47740 | 61646 | 5 | 38354 | 71288 | 6 | 28712 | 81182 | 6 | 18818 | 58 |
| 3 | 52415 | 8 | 47585 | 61805 | 8 | 38195 | 71451 | 8 | 28549 | 81349 | 9 | 18651 | 57 |
| 4 | 52569 | 10 | 47431 | 61964 | 11 | 38036 | 71614 | 11 | 28386 | 81516 | 11 | 18484 | 56 |
| 5 | 52723 | 13 | 47277 | 62122 | 13 | 37878 | 71777 | 14 | 28223 | 81683 | 14 | 18317 | 55 |
| 6 | 52878 | 16 | 47122 | 62281 | 16 | 37719 | 71940 | 16 | 28060 | 81850 | 17 | 18150 | 54 |
| 7 | 53033 | 18 | 46967 | 62440 | 19 | 37560 | 72103 | 19 | 27897 | 82018 | 20 | 17982 | 53 |
| 8 | 53187 | 20 | 46813 | 62599 | 22 | 37401 | 72266 | 22 | 27734 | 82185 | 23 | 17815 | 52 |
| 9 | 53342 | 23 | 46658 | 62758 | 24 | 37242 | 72429 | 25 | 27571 | 82352 | 25 | 17648 | 51 |
| 10 | 53497 | 26 | 46503 | 62917 | 27 | 37083 | 72593 | 27 | 27407 | 82520 | 28 | 17480 | 50 |
| 11 | 153652 | 28 | 1.846348 | 163076 | 29 | 1.836924 | 172756 | 30 | 1.827244 | 182687 | 31 | 1.817313 | 49 |
| 12 | 53807 | 31 | 46193 | 63236 | 32 | 36764 | 72919 | 33 | 27081 | 82855 | 34 | 17145 | 48 |
| 13 | 53962 | 33 | 46038 | 63395 | 35 | 36605 | 73083 | 36 | 26917 | 83023 | 36 | 16977 | 47 |
| 14 | 54117 | 36 | 45883 | 63554 | 38 | 36446 | 73247 | 38 | 26753 | 83191 | 39 | 16809 | 46 |
| 15 | 54272 | 39 | 45728 | 63714 | 40 | 36286 | 73410 | 41 | 26590 | 83358 | 42 | 16642 | 45 |
| 16 | 54427 | 41 | 45573 | 63873 | 43 | 36127 | 73574 | 44 | 26426 | 83526 | 44 | 16474 | 44 |
| 17 | 54583 | 44 | 45417 | 64033 | 46 | 35967 | 73738 | 47 | 26262 | 83694 | 47 | 16306 | 43 |
| 18 | 54738 | 47 | 45262 | 64193 | 48 | 35807 | 73902 | 49 | 26098 | 83862 | 50 | 16138 | 42 |
| 19 | 54894 | 49 | 45106 | 64352 | 51 | 35648 | 74066 | 52 | 25934 | 84030 | 53 | 15970 | 41 |
| 20 | 55049 | 52 | 44951 | 64512 | 54 | 35488 | 74230 | 55 | 25770 | 84199 | 56 | 15801 | 40 |
| 21 | 155205 | 54 | 1.844795 | 164672 | 56 | 1.835328 | 174394 | 57 | 1.825606 | 184367 | 58 | 1.815633 | 39 |
| 22 | 55360 | 57 | 44640 | 64832 | 59 | 35168 | 74558 | 60 | 25442 | 84535 | 61 | 15465 | 38 |
| 23 | 55516 | 60 | 44484 | 64992 | 62 | 35008 | 74722 | 63 | 25278 | 84704 | 64 | 15296 | 37 |
| 24 | 55672 | 62 | 44328 | 65152 | 65 | 34848 | 74887 | 65 | 25113 | 84872 | 67 | 15128 | 36 |
| 25 | 55828 | 65 | 44172 | 65312 | 67 | 34688 | 75051 | 68 | 24949 | 85041 | 70 | 14959 | 35 |
| 26 | 55984 | 68 | 44016 | 65473 | 70 | 34527 | 75215 | 71 | 24785 | 85209 | 73 | 14791 | 34 |
| 27 | 56140 | 72 | 43860 | 65633 | 72 | 34367 | 75380 | 73 | 24620 | 85378 | 76 | 14622 | 33 |
| 28 | 56296 | 74 | 43704 | 65793 | 75 | 34207 | 75544 | 76 | 24456 | 85547 | 79 | 14453 | 32 |
| 29 | 56452 | 76 | 43548 | 65954 | 78 | 34046 | 75709 | 79 | 24291 | 85716 | 82 | 14284 | 31 |
| 30 | 56609 | 78 | 43391 | 66114 | 81 | 33886 | 75874 | 82 | 24126 | 85884 | 84 | 14116 | 30 |
| 31 | 156765 | 81 | 1.843235 | 166275 | 84 | 1.833725 | 176039 | 84 | 1.823961 | 186053 | 87 | 1.813947 | 29 |
| 32 | 56921 | 84 | 43079 | 66435 | 87 | 33565 | 76203 | 87 | 23797 | 86222 | 90 | 13778 | 28 |
| 33 | 57078 | 87 | 42922 | 66596 | 90 | 33404 | 76368 | 90 | 23632 | 86392 | 93 | 13608 | 27 |
| 34 | 57234 | 90 | 42766 | 66757 | 93 | 33243 | 76533 | 93 | 23467 | 86561 | 95 | 13439 | 26 |
| 35 | 57391 | 92 | 42609 | 66918 | 95 | 33082 | 76698 | 96 | 23302 | 86730 | 98 | 13270 | 25 |
| 36 | 57548 | 94 | 42452 | 67079 | 98 | 32921 | 76864 | 99 | 23136 | 86899 | 101 | 13101 | 24 |
| 37 | 57704 | 97 | 42296 | 67240 | 101 | 32760 | 77029 | 102 | 22971 | 87069 | 104 | 12931 | 23 |
| 38 | 57861 | 99 | 42139 | 67401 | 103 | 32599 | 77194 | 105 | 22806 | 87238 | 107 | 12762 | 22 |
| 39 | 58018 | 102 | 41982 | 67562 | 106 | 32438 | 77359 | 108 | 22641 | 87408 | 110 | 12592 | 21 |
| 40 | 58175 | 105 | 41825 | 67723 | 108 | 32277 | 77525 | 111 | 22475 | 87577 | 113 | 12423 | 20 |
| 41 | 158332 | 108 | 1.841668 | 167885 | 111 | 1.832115 | 177090 | 114 | 1.822310 | 187747 | 115 | 1.812253 | 19 |
| 42 | 58489 | 111 | 41511 | 68046 | 114 | 31954 | 77856 | 116 | 22144 | 87916 | 118 | 12084 | 18 |
| 43 | 58646 | 113 | 41354 | 68207 | 116 | 31793 | 78022 | 119 | 21978 | 88086 | 121 | 11914 | 17 |
| 44 | 58804 | 115 | 41196 | 68369 | 119 | 31631 | 78187 | 122 | 21813 | 88256 | 124 | 11744 | 16 |
| 45 | 58961 | 118 | 41039 | 68530 | 121 | 31470 | 78353 | 125 | 21647 | 88426 | 127 | 11574 | 15 |
| 46 | 59118 | 121 | 40882 | 68692 | 124 | 31308 | 78519 | 128 | 21481 | 88596 | 130 | 11404 | 14 |
| 47 | 59276 | 123 | 40724 | 68854 | 127 | 31146 | 78685 | 131 | 21315 | 88766 | 133 | 11234 | 13 |
| 48 | 59433 | 126 | 40567 | 69016 | 129 | 30984 | 78851 | 134 | 21149 | 88936 | 136 | 11064 | 12 |
| 49 | 59591 | 128 | 40409 | 69177 | 132 | 30823 | 79017 | 136 | 20983 | 89106 | 139 | 10894 | 11 |
| 50 | 59749 | 131 | 40251 | 69339 | 135 | 30661 | 79183 | 139 | 20817 | 89277 | 142 | 10723 | 10 |
| 51 | 159906 | 134 | 1.840094 | 169501 | 138 | 1.830499 | 179349 | 142 | 1.820651 | 189447 | 144 | 1.810553 | 9 |
| 52 | 60064 | 136 | 39936 | 69663 | 141 | 30337 | 79515 | 145 | 20485 | 89617 | 147 | 10383 | 8 |
| 53 | 60222 | 139 | 39778 | 69826 | 143 | 30174 | 79682 | 147 | 20318 | 89788 | 150 | 10212 | 7 |
| 54 | 60380 | 142 | 39620 | 69988 | 146 | 30012 | 79848 | 150 | 20152 | 89958 | 153 | 10042 | 6 |
| 55 | 60538 | 144 | 39462 | 70150 | 148 | 29850 | 80015 | 153 | 19985 | 90129 | 156 | 09871 | 5 |
| 56 | 60696 | 147 | 39304 | 70312 | 151 | 29688 | 80181 | 156 | 19819 | 90300 | 159 | 09700 | 4 |
| 57 | 60854 | 150 | 39146 | 70475 | 154 | 29525 | 80348 | 158 | 19652 | 90470 | 162 | 09530 | 3 |
| 58 | 61013 | 152 | 38987 | 70637 | 156 | 29363 | 80514 | 161 | 19486 | 90641 | 164 | 09359 | 2 |
| 59 | 61171 | 155 | 38829 | 70800 | 159 | 29200 | 80681 | 164 | 19319 | 90812 | 167 | 09188 | 1 |
| 60 | 161329 | 157 | 1.838671 | 170962 | 162 | 1.829038 | 180848 | 166 | 1.819152 | 190983 | 170 | 1.809017 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | ′ ″ Suv. |
| | 147° | | | 146° | | | 145° | | | 144° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 36° Versed | Parts for ″ | Suvers. | 37° Versed | Parts for ″ | Suvers. | 38° Versed | Parts for ″ | Suvers. | 39° Versed | Parts for ″ | Suvers. | ″ Suv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 190983 | 0 | 1.809017 | 201364 | 0 | 1.798636 | 211989 | 0 | 1.788011 | 222854 | 0 | 1.777146 | 60 |
| 1 | 91154 | 3 | 08846 | 01540 | 3 | 98460 | 12168 | 3 | 87832 | 23037 | 3 | 76963 | 59 |
| 2 | 91325 | 6 | 08675 | 01715 | 6 | 98285 | 12348 | 6 | 87652 | 23220 | 6 | 76780 | 58 |
| 3 | 91496 | 9 | 08504 | 01890 | 9 | 98110 | 12527 | 9 | 87473 | 23404 | 9 | 76596 | 57 |
| 4 | 91667 | 11 | 08333 | 02065 | 12 | 97935 | 12706 | 12 | 87294 | 23587 | 12 | 76413 | 56 |
| 5 | 91839 | 14 | 08161 | 02241 | 15 | 97759 | 12886 | 15 | 87114 | 23770 | 15 | 76230 | 55 |
| 6 | 92010 | 17 | 07990 | 02416 | 18 | 97584 | 13065 | 18 | 86935 | 23954 | 18 | 76046 | 54 |
| 7 | 92181 | 20 | 07819 | 02592 | 20 | 97408 | 13244 | 21 | 86756 | 24137 | 21 | 75863 | 53 |
| 8 | 92353 | 23 | 07647 | 02767 | 23 | 97233 | 13424 | 24 | 86576 | 24321 | 24 | 75679 | 52 |
| 9 | 92525 | 26 | 07475 | 02943 | 26 | 97057 | 13604 | 27 | 86396 | 24504 | 27 | 75496 | 51 |
| 10 | 92696 | 29 | 07304 | 03118 | 29 | 96882 | 13783 | 30 | 86217 | 24688 | 31 | 75312 | 50 |
| 11 | 192868 | 32 | 1.807132 | 203294 | 32 | 1.796706 | 213963 | 33 | 1.786037 | 224872 | 34 | 1.775128 | 49 |
| 12 | 93040 | 34 | 06960 | 03470 | 35 | 96530 | 14143 | 36 | 85857 | 25056 | 37 | 74945 | 48 |
| 13 | 93211 | 37 | 06789 | 03646 | 38 | 96354 | 14323 | 39 | 85677 | 25239 | 40 | 74761 | 47 |
| 14 | 93383 | 40 | 06617 | 03822 | 41 | 96178 | 14503 | 42 | 85497 | 25423 | 43 | 74577 | 46 |
| 15 | 93555 | 43 | 06445 | 03998 | 44 | 96002 | 14683 | 45 | 85317 | 25607 | 46 | 74393 | 45 |
| 16 | 93727 | 46 | 06273 | 04174 | 47 | 95826 | 14863 | 48 | 85137 | 25791 | 49 | 74209 | 44 |
| 17 | 93899 | 49 | 06101 | 04350 | 50 | 95650 | 15043 | 51 | 84957 | 25976 | 52 | 74024 | 43 |
| 18 | 94072 | 52 | 05928 | 04527 | 53 | 95473 | 15224 | 54 | 84776 | 26160 | 55 | 73840 | 42 |
| 19 | 94244 | 55 | 05756 | 04703 | 56 | 95297 | 15404 | 57 | 84596 | 26344 | 58 | 73656 | 41 |
| 20 | 94416 | 57 | 05584 | 04879 | 59 | 95121 | 15584 | 60 | 84416 | 26528 | 61 | 73472 | 40 |
| 21 | 194589 | 60 | 1.805411 | 205056 | 62 | 1.794944 | 215765 | 63 | 1.784235 | 226713 | 65 | 1.773287 | 39 |
| 22 | 94761 | 63 | 05239 | 05232 | 65 | 94768 | 15945 | 66 | 84055 | 26897 | 68 | 73103 | 38 |
| 23 | 94934 | 66 | 05066 | 05409 | 68 | 94591 | 16126 | 69 | 83874 | 27082 | 71 | 72918 | 37 |
| 24 | 95106 | 69 | 04894 | 05585 | 71 | 94415 | 16306 | 72 | 83694 | 27266 | 74 | 72734 | 36 |
| 25 | 95279 | 72 | 04721 | 05762 | 74 | 94238 | 16487 | 75 | 83513 | 27451 | 77 | 72549 | 35 |
| 26 | 95452 | 75 | 04548 | 05939 | 76 | 94061 | 16668 | 78 | 83332 | 27636 | 80 | 72364 | 34 |
| 27 | 95624 | 78 | 04376 | 06116 | 79 | 93884 | 16849 | 81 | 83151 | 27821 | 83 | 72179 | 33 |
| 28 | 95797 | 81 | 04203 | 06293 | 82 | 93707 | 17030 | 84 | 82970 | 28005 | 86 | 71995 | 32 |
| 29 | 95970 | 84 | 04030 | 06470 | 85 | 93530 | 17211 | 87 | 82789 | 28190 | 89 | 71810 | 31 |
| 30 | 96143 | 86 | 03857 | 06647 | 88 | 93353 | 17392 | 90 | 82608 | 28375 | 92 | 71625 | 30 |
| 31 | 196316 | 89 | 1.803684 | 206824 | 92 | 1.793176 | 217573 | 91 | 1.782427 | 228560 | 97 | 1.771440 | 29 |
| 32 | 96489 | 92 | 03511 | 07001 | 95 | 92999 | 17754 | 97 | 82246 | 28746 | 100 | 71254 | 28 |
| 33 | 96662 | 95 | 03338 | 07178 | 98 | 92822 | 17935 | 100 | 82065 | 28931 | 103 | 71069 | 27 |
| 34 | 96836 | 98 | 03164 | 07356 | 101 | 92644 | 18117 | 103 | 81883 | 29116 | 106 | 70884 | 26 |
| 35 | 97009 | 101 | 02991 | 07533 | 104 | 92467 | 18298 | 106 | 81702 | 29301 | 109 | 70699 | 25 |
| 36 | 97182 | 104 | 02818 | 07710 | 107 | 92290 | 18480 | 109 | 81520 | 29487 | 112 | 70513 | 24 |
| 37 | 97356 | 107 | 02644 | 07888 | 110 | 92112 | 18661 | 112 | 81339 | 29672 | 115 | 70328 | 23 |
| 38 | 97529 | 110 | 02471 | 08065 | 113 | 91935 | 18843 | 115 | 81157 | 29858 | 118 | 70142 | 22 |
| 39 | 97703 | 113 | 02297 | 08243 | 116 | 91757 | 19024 | 118 | 80976 | 30043 | 121 | 69957 | 21 |
| 40 | 97877 | 116 | 02123 | 08421 | 119 | 91579 | 19206 | 121 | 80794 | 30229 | 124 | 69771 | 20 |
| 41 | 198050 | 118 | 1.801950 | 208599 | 121 | 1.791401 | 219388 | 125 | 1.780612 | 230415 | 127 | 1.769585 | 19 |
| 42 | 98224 | 121 | 01776 | 08776 | 124 | 91224 | 19570 | 128 | 80430 | 30600 | 130 | 69400 | 18 |
| 43 | 98398 | 124 | 01602 | 08954 | 127 | 91046 | 19751 | 131 | 80249 | 30786 | 133 | 69214 | 17 |
| 44 | 98572 | 127 | 01428 | 09132 | 130 | 90868 | 19933 | 134 | 80067 | 30972 | 136 | 69028 | 16 |
| 45 | 98746 | 130 | 01254 | 09310 | 133 | 90690 | 20116 | 137 | 79884 | 31158 | 139 | 68842 | 15 |
| 46 | 98920 | 133 | 01080 | 09488 | 136 | 90512 | 20298 | 140 | 79702 | 31344 | 143 | 68656 | 14 |
| 47 | 99094 | 136 | 00906 | 09667 | 139 | 90333 | 20480 | 143 | 79520 | 31530 | 146 | 68470 | 13 |
| 48 | 99269 | 139 | 00731 | 09845 | 142 | 90155 | 20662 | 146 | 79338 | 31716 | 149 | 68284 | 12 |
| 49 | 99443 | 142 | 00557 | 10023 | 145 | 89977 | 20844 | 149 | 79156 | 31903 | 152 | 68097 | 11 |
| 50 | 99617 | 145 | 00383 | 10202 | 148 | 89798 | 21027 | 152 | 78973 | 32089 | 155 | 67911 | 10 |
| 51 | 199792 | 147 | 1.800208 | 210380 | 151 | 1.789620 | 221209 | 155 | 1.778791 | 232275 | 158 | 1.767725 | 9 |
| 52 | 199966 | 150 | 1.800034 | 10559 | 154 | 89441 | 21392 | 158 | 78608 | 32462 | 161 | 67538 | 8 |
| 53 | 200141 | 153 | 1.799859 | 10737 | 157 | 89263 | 21574 | 161 | 78426 | 32648 | 164 | 67352 | 7 |
| 54 | 00315 | 156 | 99685 | 10916 | 160 | 89084 | 21757 | 164 | 78243 | 32835 | 167 | 67165 | 6 |
| 55 | 00490 | 159 | 99510 | 11095 | 163 | 88905 | 21940 | 167 | 78060 | 33021 | 171 | 66979 | 5 |
| 56 | 00665 | 162 | 99335 | 11273 | 166 | 88727 | 22122 | 170 | 77878 | 33208 | 174 | 66792 | 4 |
| 57 | 00840 | 165 | 99160 | 11452 | 169 | 88548 | 22305 | 173 | 77695 | 33395 | 177 | 66605 | 3 |
| 58 | 01015 | 168 | 98985 | 11631 | 172 | 88369 | 22488 | 176 | 77512 | 33582 | 180 | 66418 | 2 |
| 59 | 01189 | 171 | 98811 | 11810 | 175 | 88190 | 22671 | 179 | 77329 | 33769 | 183 | 66231 | 1 |
| 60 | 201364 | 174 | 1.798636 | 211989 | 178 | 1.788011 | 22854 | 182 | 1.777146 | 233956 | 186 | 1.766044 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv |
| | 143° | | | 142° | | | 141° | | | 140° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 40° Versed. | Parts for ″ | Suvers. | 41° Versed | Parts for ″ | Suvers. | 42° Versed | Parts for ″ | Suvers. | 43° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 233956 | 0 | 1.766044 | 245290 | 0 | 1.754710 | 256855 | 0 | 1.743145 | 268646 | 0 | 1.731354 | 60 |
| 1 | 34143 | 3 | 65857 | 45481 | 3 | 54519 | 57050 | 3 | 42950 | 68845 | 3 | 31155 | 59 |
| 2 | 34330 | 6 | 65670 | 45672 | 6 | 54328 | 57245 | 7 | 42755 | 69043 | 7 | 30957 | 58 |
| 3 | 34517 | 9 | 65483 | 45863 | 10 | 54137 | 57439 | 10 | 42561 | 69242 | 10 | 30758 | 57 |
| 4 | 34704 | 13 | 65296 | 46054 | 13 | 53946 | 57634 | 13 | 42366 | 69440 | 13 | 30560 | 56 |
| 5 | 34891 | 16 | 65109 | 46245 | 16 | 53755 | 57829 | 17 | 42171 | 69639 | 16 | 30361 | 55 |
| 6 | 35079 | 19 | 64921 | 46437 | 19 | 53563 | 58024 | 20 | 41976 | 69838 | 20 | 30162 | 54 |
| 7 | 35266 | 22 | 64734 | 46628 | 22 | 53372 | 58219 | 23 | 41781 | 70037 | 23 | 29963 | 53 |
| 8 | 35453 | 25 | 64547 | 46819 | 25 | 53181 | 58414 | 26 | 41586 | 70235 | 26 | 29765 | 52 |
| 9 | 35641 | 28 | 64359 | 47011 | 28 | 52989 | 58609 | 29 | 41391 | 70434 | 29 | 29566 | 51 |
| 10 | 35829 | 31 | 64171 | 47202 | 32 | 52798 | 58805 | 33 | 41195 | 70633 | 33 | 29367 | 50 |
| 11 | 236016 | 34 | 1.763984 | 247394 | 35 | 1.752606 | 259000 | 36 | 1.741000 | 270832 | 36 | 1.729168 | 49 |
| 12 | 36204 | 38 | 63796 | 47585 | 38 | 52415 | 59195 | 39 | 40805 | 71031 | 39 | 28969 | 48 |
| 13 | 36392 | 41 | 63608 | 47777 | 41 | 52223 | 59391 | 42 | 40609 | 71230 | 42 | 28770 | 47 |
| 14 | 36580 | 44 | 63420 | 47968 | 44 | 52032 | 59586 | 45 | 40414 | 71430 | 46 | 28570 | 46 |
| 15 | 36768 | 47 | 63232 | 48160 | 48 | 51840 | 59782 | 49 | 40218 | 71629 | 50 | 28371 | 45 |
| 16 | 36956 | 50 | 63044 | 48352 | 51 | 51648 | 59977 | 52 | 40023 | 71828 | 53 | 28172 | 44 |
| 17 | 37144 | 53 | 62856 | 48544 | 54 | 51456 | 60173 | 55 | 39827 | 72028 | 56 | 27972 | 43 |
| 18 | 37332 | 57 | 62668 | 48736 | 57 | 51264 | 60369 | 58 | 39631 | 72227 | 60 | 27773 | 42 |
| 19 | 37520 | 60 | 62480 | 48928 | 60 | 51072 | 60565 | 62 | 39435 | 72427 | 63 | 27573 | 41 |
| 20 | 37708 | 63 | 62292 | 49120 | 64 | 50880 | 60761 | 65 | 39239 | 72626 | 66 | 27374 | 40 |
| 21 | 237896 | 66 | 1.762104 | 249312 | 67 | 1.750688 | 260957 | 68 | 1.739043 | 272826 | 70 | 1.727174 | 39 |
| 22 | 38085 | 69 | 61915 | 49504 | 70 | 50496 | 61152 | 71 | 38848 | 73026 | 73 | 26974 | 38 |
| 23 | 38273 | 72 | 61727 | 49697 | 73 | 50303 | 61349 | 75 | 38651 | 73225 | 76 | 26775 | 37 |
| 24 | 38462 | 75 | 61538 | 49889 | 76 | 50111 | 61545 | 78 | 38455 | 73425 | 80 | 26575 | 36 |
| 25 | 38650 | 78 | 61350 | 50081 | 80 | 49919 | 61741 | 81 | 38259 | 73625 | 83 | 26375 | 35 |
| 26 | 38839 | 82 | 61161 | 50274 | 83 | 49726 | 61937 | 84 | 38063 | 73825 | 86 | 26175 | 34 |
| 27 | 39028 | 85 | 60972 | 50466 | 86 | 49534 | 62133 | 88 | 37867 | 74025 | 90 | 25975 | 33 |
| 28 | 39216 | 88 | 60784 | 50659 | 89 | 49341 | 62330 | 91 | 37670 | 74225 | 93 | 25775 | 32 |
| 29 | 39405 | 91 | 60595 | 50852 | 92 | 49148 | 62526 | 94 | 37474 | 74425 | 96 | 25575 | 31 |
| 30 | 39594 | 94 | 60406 | 51044 | 96 | 48956 | 62723 | 98 | 37277 | 74626 | 100 | 25374 | 30 |
| 31 | 239783 | 98 | 1.760217 | 251237 | 101 | 1.748763 | 262919 | 103 | 1.737081 | 274826 | 104 | 1.725174 | 29 |
| 32 | 39972 | 101 | 60028 | 51430 | 104 | 48570 | 63116 | 106 | 36884 | 75026 | 107 | 24974 | 28 |
| 33 | 40161 | 105 | 59839 | 51623 | 107 | 48377 | 63313 | 110 | 36687 | 75227 | 110 | 24773 | 27 |
| 34 | 40350 | 108 | 59650 | 51816 | 110 | 48184 | 63509 | 113 | 36491 | 75427 | 113 | 24573 | 26 |
| 35 | 40539 | 111 | 59461 | 52009 | 113 | 47991 | 63706 | 116 | 36294 | 75628 | 117 | 24372 | 25 |
| 36 | 40729 | 114 | 59271 | 52202 | 117 | 47798 | 63903 | 119 | 36097 | 75828 | 120 | 24172 | 24 |
| 37 | 40918 | 117 | 59082 | 52395 | 120 | 47605 | 64100 | 123 | 35900 | 76029 | 123 | 23971 | 23 |
| 38 | 41107 | 120 | 58893 | 52588 | 123 | 47412 | 64297 | 126 | 35703 | 76229 | 127 | 23771 | 22 |
| 39 | 41297 | 123 | 58703 | 52782 | 126 | 47218 | 64494 | 129 | 35506 | 76430 | 130 | 23570 | 21 |
| 40 | 41486 | 127 | 58514 | 52975 | 129 | 47025 | 64691 | 132 | 35309 | 76631 | 134 | 23369 | 20 |
| 41 | 241676 | 130 | 1.758324 | 253168 | 133 | 1.746832 | 264888 | 135 | 1.735112 | 276832 | 137 | 1.723168 | 19 |
| 42 | 41866 | 133 | 58134 | 53362 | 136 | 46638 | 65085 | 139 | 34915 | 77033 | 141 | 22967 | 18 |
| 43 | 42055 | 136 | 57945 | 53555 | 139 | 46445 | 65283 | 142 | 34717 | 77234 | 144 | 22766 | 17 |
| 44 | 42245 | 139 | 57755 | 53749 | 142 | 46251 | 65480 | 145 | 34520 | 77435 | 147 | 22565 | 16 |
| 45 | 42435 | 142 | 57565 | 53943 | 145 | 46057 | 65677 | 149 | 34323 | 77636 | 150 | 22364 | 15 |
| 46 | 42625 | 146 | 57375 | 54136 | 149 | 45864 | 65875 | 152 | 34125 | 77837 | 154 | 22163 | 14 |
| 47 | 42815 | 149 | 57185 | 54330 | 152 | 45670 | 66073 | 155 | 33927 | 78038 | 157 | 21962 | 13 |
| 48 | 43005 | 152 | 56995 | 54524 | 155 | 45476 | 66270 | 158 | 33730 | 78240 | 161 | 21760 | 12 |
| 49 | 43195 | 155 | 56805 | 54718 | 159 | 45282 | 66468 | 162 | 33532 | 78441 | 164 | 21559 | 11 |
| 50 | 43385 | 158 | 56615 | 54912 | 162 | 45088 | 66666 | 165 | 33334 | 78643 | 168 | 21357 | 10 |
| 51 | 243575 | 161 | 1.756425 | 255106 | 166 | 1.744894 | 266863 | 169 | 1.733137 | 278844 | 171 | 1.721156 | 9 |
| 52 | 43766 | 165 | 56234 | 55300 | 169 | 44700 | 67061 | 172 | 32939 | 79046 | 174 | 20954 | 8 |
| 53 | 43956 | 168 | 56044 | 55494 | 172 | 44506 | 67259 | 175 | 32741 | 79247 | 177 | 20753 | 7 |
| 54 | 44146 | 171 | 55854 | 55688 | 175 | 44312 | 67457 | 178 | 32543 | 79449 | 181 | 20551 | 6 |
| 55 | 44337 | 174 | 55663 | 55883 | 178 | 44117 | 67655 | 182 | 32345 | 79651 | 184 | 20349 | 5 |
| 56 | 44528 | 177 | 55472 | 56077 | 181 | 43923 | 67853 | 185 | 32147 | 79852 | 188 | 20148 | 4 |
| 57 | 44718 | 180 | 55282 | 56272 | 184 | 43728 | 68051 | 188 | 31949 | 80054 | 191 | 19946 | 3 |
| 58 | 44909 | 184 | 55091 | 56466 | 188 | 43534 | 68250 | 191 | 31750 | 80256 | 194 | 19744 | 2 |
| 59 | 45100 | 187 | 54900 | 56661 | 191 | 43339 | 68448 | 194 | 31552 | 80458 | 197 | 19542 | 1 |
| 60 | 245290 | 190 | 1.754710 | 256855 | 194 | 1.743145 | 268646 | 197 | 1.731354 | 280660 | 201 | 1.719340 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ″ Suv. |
| | 139° | | | 138° | | | 137° | | | 136° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 44° Versed. | Parts for ″ | 44° Suvers. | 45° Versed. | Parts for ″ | 45° Suvers. | 46° Versed. | Parts for ″ | 46° Suvers. | 47° Versed. | Parts for ″ | 47° Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 280660 | 0 | 1.719340 | 292893 | 0 | 1.707107 | 305342 | 0 | 1.694658 | 318002 | 0 | 1.681998 | 60 |
| 1 | 80862 | 3 | 19138 | 93099 | 3 | 06901 | 05551 | 3 | 94449 | 18214 | 4 | 81786 | 59 |
| 2 | 81064 | 7 | 18936 | 93305 | 7 | 06695 | 05760 | 7 | 94240 | 18427 | 7 | 81573 | 58 |
| 3 | 81267 | 10 | 18733 | 93511 | 10 | 06489 | 05970 | 11 | 94030 | 18640 | 10 | 81360 | 57 |
| 4 | 81469 | 14 | 18531 | 93716 | 14 | 06284 | 06179 | 14 | 93821 | 18853 | 14 | 81147 | 56 |
| 5 | 81671 | 17 | 18329 | 93922 | 17 | 06078 | 06389 | 18 | 93611 | 19066 | 18 | 80934 | 55 |
| 6 | 81874 | 20 | 18126 | 94128 | 21 | 05872 | 06598 | 21 | 93402 | 19279 | 21 | 80721 | 54 |
| 7 | 82076 | 24 | 17924 | 94334 | 24 | 05666 | 06808 | 25 | 93192 | 19492 | 25 | 80508 | 53 |
| 8 | 82279 | 27 | 17721 | 94541 | 28 | 05459 | 07017 | 28 | 92983 | 19705 | 28 | 80295 | 52 |
| 9 | 82481 | 31 | 17519 | 94747 | 31 | 05253 | 07227 | 32 | 92773 | 19919 | 32 | 80081 | 51 |
| 10 | 82684 | 34 | 17316 | 94953 | 34 | 05047 | 07437 | 35 | 92563 | 20132 | 36 | 79868 | 50 |
| 11 | 282887 | 38 | 1.717113 | 295159 | 38 | 1.704841 | 307647 | 39 | 1.692353 | 320345 | 39 | 1.679655 | 49 |
| 12 | 83089 | 41 | 16911 | 95366 | 41 | 04634 | 07857 | 42 | 92143 | 20559 | 43 | 79441 | 48 |
| 13 | 83292 | 45 | 16708 | 95572 | 45 | 04428 | 08067 | 46 | 91933 | 20772 | 46 | 79228 | 47 |
| 14 | 83495 | 48 | 16505 | 95779 | 48 | 04221 | 08277 | 49 | 91723 | 20986 | 50 | 79014 | 46 |
| 15 | 83698 | 51 | 16302 | 95985 | 52 | 04015 | 08487 | 52 | 91513 | 21199 | 53 | 78801 | 45 |
| 16 | 83901 | 55 | 16099 | 96192 | 55 | 03808 | 08697 | 56 | 91303 | 21413 | 57 | 78587 | 44 |
| 17 | 84104 | 58 | 15896 | 96399 | 59 | 03601 | 08907 | 59 | 91093 | 21627 | 60 | 78373 | 43 |
| 18 | 84307 | 62 | 15693 | 96605 | 62 | 03395 | 09118 | 63 | 90882 | 21840 | 64 | 78160 | 42 |
| 19 | 84510 | 65 | 15490 | 96812 | 66 | 03188 | 09328 | 66 | 90672 | 22054 | 67 | 77946 | 41 |
| 20 | 84714 | 68 | 15286 | 97019 | 69 | 02981 | 09538 | 70 | 90462 | 22268 | 71 | 77732 | 40 |
| 21 | 284917 | 72 | 1.715083 | 297226 | 73 | 1.702774 | 309749 | 73 | 1.690251 | 322482 | 74 | 1.677518 | 39 |
| 22 | 85120 | 75 | 14880 | 97433 | 76 | 02567 | 09959 | 77 | 90041 | 22696 | 78 | 77304 | 38 |
| 23 | 85324 | 79 | 14676 | 97640 | 80 | 02360 | 10170 | 80 | 89830 | 22910 | 81 | 77090 | 37 |
| 24 | 85527 | 82 | 14473 | 97847 | 83 | 02153 | 10380 | 84 | 89620 | 23124 | 85 | 76876 | 36 |
| 25 | 85731 | 85 | 14269 | 98054 | 86 | 01946 | 10591 | 87 | 89409 | 23338 | 89 | 76662 | 35 |
| 26 | 85934 | 88 | 14066 | 98261 | 90 | 01739 | 10802 | 91 | 89198 | 23552 | 92 | 76448 | 34 |
| 27 | 86138 | 92 | 13862 | 98469 | 93 | 01531 | 11013 | 94 | 88987 | 23767 | 96 | 76233 | 33 |
| 28 | 86342 | 96 | 13658 | 98676 | 97 | 01324 | 11224 | 98 | 88776 | 23981 | 99 | 76019 | 32 |
| 29 | 86546 | 99 | 13454 | 98883 | 100 | 01117 | 11434 | 101 | 88566 | 24195 | 103 | 75805 | 31 |
| 30 | 86750 | 102 | 13250 | 99091 | 103 | 00909 | 11645 | 105 | 88355 | 24410 | 107 | 75590 | 30 |
| 31 | 286953 | 106 | 1.713047 | 299298 | 107 | 1.700702 | 311856 | 110 | 1.688144 | 324624 | 111 | 1.675376 | 29 |
| 32 | 87157 | 109 | 12843 | 99506 | 111 | 00494 | 12068 | 113 | 87932 | 24839 | 115 | 75161 | 28 |
| 33 | 87361 | 112 | 12639 | 99713 | 114 | 00287 | 12279 | 117 | 87721 | 25053 | 118 | 74947 | 27 |
| 34 | 87566 | 116 | 12434 | 299921 | 118 | 1.700079 | 12490 | 120 | 87510 | 25268 | 122 | 74732 | 26 |
| 35 | 87770 | 119 | 12230 | 300129 | 121 | 1.699871 | 12701 | 124 | 87299 | 25483 | 125 | 74517 | 25 |
| 36 | 87974 | 123 | 12026 | 00337 | 125 | 99663 | 12912 | 127 | 87088 | 25698 | 129 | 74302 | 24 |
| 37 | 88178 | 126 | 11822 | 00545 | 128 | 99455 | 13124 | 131 | 86876 | 25912 | 133 | 74088 | 23 |
| 38 | 88383 | 130 | 11617 | 00752 | 132 | 99248 | 13335 | 134 | 86665 | 26127 | 136 | 73873 | 22 |
| 39 | 88587 | 133 | 11413 | 00960 | 135 | 99040 | 13547 | 138 | 86453 | 26342 | 140 | 73658 | 21 |
| 40 | 88791 | 137 | 11209 | 01168 | 139 | 98832 | 13758 | 141 | 86242 | 26557 | 143 | 73443 | 20 |
| 41 | 288996 | 140 | 1.711004 | 301377 | 142 | 1.698623 | 313970 | 144 | 1.686030 | 326772 | 147 | 1.673228 | 19 |
| 42 | 89201 | 143 | 10799 | 01585 | 145 | 98415 | 14182 | 148 | 85818 | 26987 | 151 | 73013 | 18 |
| 43 | 89405 | 146 | 10595 | 01793 | 149 | 98207 | 14393 | 152 | 85607 | 27203 | 154 | 72797 | 17 |
| 44 | 89610 | 150 | 10390 | 02001 | 152 | 97999 | 14605 | 156 | 85395 | 27418 | 158 | 72582 | 16 |
| 45 | 89815 | 153 | 10185 | 02210 | 156 | 97790 | 14817 | 159 | 85183 | 27633 | 161 | 72367 | 15 |
| 46 | 90019 | 157 | 09981 | 02418 | 159 | 97582 | 15029 | 163 | 84971 | 27849 | 165 | 72151 | 14 |
| 47 | 90224 | 160 | 09776 | 02626 | 163 | 97374 | 15241 | 167 | 84759 | 28064 | 169 | 71936 | 13 |
| 48 | 90429 | 164 | 09571 | 02835 | 166 | 97165 | 15453 | 170 | 84547 | 28279 | 172 | 71721 | 12 |
| 49 | 90634 | 167 | 09366 | 03043 | 170 | 96957 | 15665 | 174 | 84335 | 28495 | 176 | 71505 | 11 |
| 50 | 90839 | 171 | 09161 | 03252 | 173 | 96748 | 15877 | 177 | 84123 | 28710 | 179 | 71290 | 10 |
| 51 | 291044 | 174 | 1.708956 | 303461 | 177 | 1.696539 | 316089 | 181 | 1.683911 | 328926 | 183 | 1.671074 | 9 |
| 52 | 91250 | 177 | 08750 | 03670 | 180 | 96330 | 16302 | 184 | 83698 | 29142 | 186 | 70858 | 8 |
| 53 | 91455 | 181 | 08545 | 03878 | 184 | 96122 | 16514 | 188 | 83486 | 29358 | 190 | 70642 | 7 |
| 54 | 91660 | 184 | 08340 | 04087 | 187 | 95913 | 16726 | 191 | 83274 | 29573 | 193 | 70427 | 6 |
| 55 | 91865 | 188 | 08135 | 04296 | 191 | 95704 | 16939 | 195 | 83061 | 29789 | 197 | 70211 | 5 |
| 56 | 92071 | 191 | 07929 | 04505 | 194 | 95495 | 17151 | 198 | 82849 | 30005 | 201 | 69995 | 4 |
| 57 | 92276 | 195 | 07724 | 04714 | 198 | 95286 | 17364 | 202 | 82636 | 30221 | 204 | 69779 | 3 |
| 58 | 92482 | 198 | 07518 | 04923 | 201 | 95077 | 17576 | 205 | 82424 | 30437 | 208 | 69563 | 2 |
| 59 | 92688 | 202 | 07312 | 05132 | 205 | 94868 | 17789 | 209 | 82211 | 30653 | 211 | 69347 | 1 |
| 60 | 292893 | 205 | 1.707107 | 305342 | 208 | 1.694658 | 318002 | 212 | 1.681998 | 330869 | 214 | 1.669131 | 0 |
| ″ Vers. | 135° Suvers. | Parts for ″ | 135° Versed. | 134° Suvers. | Parts for ″ | 134° Versed. | 133° Suvers. | Parts for ″ | 133° Versed. | 132° Suvers. | Parts for ″ | 132° Versed. | ′ ″ Suv. |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ | 48° | | | 49° | | | 50° | | | 51° | | | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ″ Vers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | Sus. |
| 0 | 330869 | 0 | 1.669131 | 343941 | 0 | 1.656059 | 357212 | 0 | 1.642788 | 370680 | 0 | 1.629320 | 60 |
| 1 | 31086 | 4 | 68914 | 44160 | 4 | 55840 | 57435 | 4 | 42565 | 70906 | 4 | 29094 | 59 |
| 2 | 31302 | 7 | 68698 | 44380 | 7 | 55620 | 57658 | 8 | 42342 | 71132 | 8 | 28868 | 58 |
| 3 | 31518 | 11 | 68482 | 44600 | 11 | 55400 | 57881 | 11 | 42119 | 71358 | 11 | 28642 | 57 |
| 4 | 31735 | 14 | 68265 | 44820 | 15 | 55180 | 58104 | 15 | 41896 | 71584 | 15 | 28416 | 56 |
| 5 | 31951 | 18 | 68049 | 45039 | 19 | 54961 | 58327 | 19 | 41673 | 71811 | 19 | 28189 | 55 |
| 6 | 32167 | 22 | 67833 | 45259 | 22 | 54741 | 58550 | 22 | 41450 | 72037 | 23 | 27963 | 54 |
| 7 | 32384 | 25 | 67616 | 45479 | 26 | 54521 | 58774 | 26 | 41226 | 72263 | 26 | 27737 | 53 |
| 8 | 32601 | 29 | 67399 | 45699 | 30 | 54301 | 58997 | 30 | 41003 | 72490 | 30 | 27510 | 52 |
| 9 | 32817 | 32 | 67183 | 45919 | 33 | 54081 | 59220 | 34 | 40780 | 72716 | 34 | 27284 | 51 |
| 10 | 33034 | 36 | 66966 | 46139 | 37 | 53861 | 59443 | 37 | 40557 | 72943 | 38 | 27057 | 50 |
| 11 | 333251 | 39 | 1.666749 | 346359 | 41 | 1.653641 | 359667 | 41 | 1.640333 | 373170 | 42 | 1.626830 | 49 |
| 12 | 33468 | 43 | 66532 | 46579 | 44 | 53421 | 59890 | 45 | 40110 | 73396 | 45 | 26604 | 48 |
| 13 | 33684 | 46 | 66316 | 46800 | 48 | 53200 | 60114 | 49 | 39886 | 73623 | 49 | 26377 | 47 |
| 14 | 33901 | 50 | 66099 | 47020 | 52 | 52980 | 60337 | 53 | 39663 | 73850 | 53 | 26150 | 46 |
| 15 | 34118 | 54 | 65882 | 47240 | 55 | 52760 | 60561 | 56 | 39439 | 74077 | 57 | 25923 | 45 |
| 16 | 34335 | 57 | 65665 | 47461 | 59 | 52539 | 60785 | 60 | 39215 | 74303 | 61 | 25697 | 44 |
| 17 | 34552 | 61 | 65448 | 47681 | 63 | 52319 | 61008 | 64 | 38992 | 74530 | 64 | 25470 | 43 |
| 18 | 34770 | 64 | 65230 | 47902 | 66 | 52098 | 61232 | 68 | 38768 | 74757 | 68 | 25243 | 42 |
| 19 | 34987 | 68 | 65013 | 48122 | 70 | 51878 | 61456 | 72 | 38544 | 74984 | 72 | 25016 | 41 |
| 20 | 35204 | 72 | 64796 | 48343 | 73 | 51657 | 61680 | 75 | 38320 | 75211 | 76 | 24789 | 40 |
| 21 | 335421 | 75 | 1.664579 | 348563 | 77 | 1.651437 | 361904 | 78 | 1.638096 | 375439 | 80 | 1.624561 | 39 |
| 22 | 35639 | 79 | 64361 | 48784 | 81 | 51216 | 62128 | 82 | 37872 | 75666 | 84 | 24334 | 38 |
| 23 | 35856 | 82 | 64144 | 49005 | 85 | 50995 | 62352 | 86 | 37648 | 75893 | 88 | 24107 | 37 |
| 24 | 36074 | 86 | 63926 | 49226 | 89 | 50774 | 62576 | 90 | 37424 | 76120 | 92 | 23880 | 36 |
| 25 | 36291 | 90 | 63709 | 49447 | 93 | 50553 | 62800 | 94 | 37200 | 76348 | 95 | 23652 | 35 |
| 26 | 36509 | 93 | 63491 | 49668 | 96 | 50332 | 63024 | 97 | 36976 | 76575 | 99 | 23425 | 34 |
| 27 | 36727 | 97 | 63273 | 49889 | 100 | 50111 | 63249 | 101 | 36751 | 76803 | 103 | 23197 | 33 |
| 28 | 36944 | 101 | 63056 | 50110 | 103 | 49890 | 63473 | 105 | 36527 | 77030 | 107 | 22970 | 32 |
| 29 | 37162 | 105 | 62838 | 50331 | 107 | 49669 | 63697 | 109 | 36303 | 77258 | 111 | 22742 | 31 |
| 30 | 37380 | 109 | 62620 | 50552 | 110 | 49448 | 63922 | 112 | 36078 | 77485 | 114 | 22515 | 30 |
| 31 | 337598 | 114 | 1.662402 | 350773 | 115 | 1.649227 | 364146 | 117 | 1.635854 | 377713 | 119 | 1.622287 | 29 |
| 32 | 37816 | 118 | 62184 | 50994 | 118 | 49006 | 64371 | 121 | 35629 | 77941 | 123 | 22059 | 28 |
| 33 | 38034 | 121 | 61966 | 51216 | 122 | 48784 | 64595 | 124 | 35405 | 78169 | 127 | 21831 | 27 |
| 34 | 38252 | 125 | 61748 | 51437 | 126 | 48563 | 64820 | 128 | 35180 | 78390 | 131 | 21604 | 26 |
| 35 | 38470 | 128 | 61530 | 51659 | 129 | 48341 | 65045 | 131 | 34955 | 78624 | 134 | 21376 | 25 |
| 36 | 38688 | 132 | 61312 | 51880 | 133 | 48120 | 65269 | 134 | 34731 | 78852 | 138 | 21148 | 24 |
| 37 | 38906 | 136 | 61094 | 52102 | 137 | 47898 | 65494 | 138 | 34506 | 79080 | 142 | 20920 | 23 |
| 38 | 39125 | 139 | 60875 | 52323 | 141 | 47677 | 65719 | 142 | 34281 | 79308 | 146 | 20692 | 22 |
| 39 | 39343 | 143 | 60657 | 52545 | 144 | 47455 | 65944 | 146 | 34056 | 79536 | 150 | 20464 | 21 |
| 40 | 39561 | 146 | 60439 | 52767 | 148 | 47233 | 66169 | 150 | 33831 | 79765 | 153 | 20235 | 20 |
| 41 | 339780 | 150 | 1.660220 | 352988 | 152 | 1.647012 | 366394 | 153 | 1.633606 | 379993 | 157 | 1.620007 | 19 |
| 42 | 39998 | 154 | 60002 | 53210 | 155 | 46790 | 66619 | 157 | 33381 | 80221 | 161 | 19779 | 18 |
| 43 | 40217 | 157 | 59783 | 53432 | 159 | 46568 | 66844 | 161 | 33156 | 80449 | 165 | 19551 | 17 |
| 44 | 40435 | 161 | 59565 | 53654 | 163 | 46346 | 67069 | 165 | 32931 | 80678 | 169 | 19322 | 16 |
| 45 | 40654 | 164 | 59346 | 53876 | 167 | 46124 | 67295 | 169 | 32705 | 80906 | 172 | 19094 | 15 |
| 46 | 40873 | 168 | 59127 | 54098 | 171 | 45902 | 67520 | 172 | 32480 | 81135 | 176 | 18865 | 14 |
| 47 | 41092 | 172 | 58908 | 54320 | 174 | 45680 | 67745 | 176 | 32255 | 81363 | 180 | 18637 | 13 |
| 48 | 41310 | 175 | 58690 | 54542 | 178 | 45458 | 67971 | 180 | 32029 | 81592 | 184 | 18408 | 12 |
| 49 | 41529 | 179 | 58471 | 54764 | 181 | 45236 | 68196 | 183 | 31804 | 81820 | 188 | 18180 | 11 |
| 50 | 41748 | 183 | 58252 | 54987 | 185 | 45013 | 68422 | 187 | 31578 | 82049 | 191 | 17951 | 10 |
| 51 | 341967 | 187 | 1.658033 | 355209 | 188 | 1.644791 | 368647 | 191 | 1.631353 | 382278 | 195 | 1.617722 | 9 |
| 52 | 42186 | 190 | 57814 | 55431 | 192 | 44569 | 68873 | 195 | 31127 | 82506 | 199 | 17494 | 8 |
| 53 | 42406 | 194 | 57594 | 55654 | 196 | 44346 | 69098 | 199 | 30902 | 82735 | 203 | 17265 | 7 |
| 54 | 42625 | 197 | 57375 | 55876 | 200 | 44124 | 69324 | 202 | 30676 | 82964 | 206 | 17036 | 6 |
| 55 | 42844 | 201 | 57156 | 56099 | 204 | 43901 | 69550 | 206 | 30450 | 83193 | 210 | 16807 | 5 |
| 56 | 43063 | 204 | 56937 | 56321 | 207 | 43679 | 69776 | 210 | 30224 | 83422 | 214 | 16578 | 4 |
| 57 | 43283 | 208 | 56717 | 56544 | 211 | 43456 | 70002 | 214 | 29998 | 83651 | 218 | 16349 | 3 |
| 58 | 43502 | 212 | 56498 | 56767 | 215 | 43233 | 70228 | 218 | 29772 | 83880 | 221 | 16120 | 2 |
| 59 | 43721 | 215 | 56279 | 56990 | 218 | 43010 | 70454 | 221 | 29546 | 84109 | 225 | 15891 | 1 |
| 60 | 343941 | 219 | 1.656059 | 357212 | 222 | 1.642788 | 370680 | 225 | 1.629320 | 384339 | 228 | 1.615661 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Sus. |
| | 131° | | | 130° | | | 129° | | | 128° | | | |

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 52° Versed | Parts for ″ | Suvers. | 53° Versed | Parts for ″ | Suvers. | 54° Versed | Parts for ″ | Suvers. | 55° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 384339 | 0 | 1.615661 | 398185 | 0 | 1.601815 | 412215 | 0 | 1.587785 | 426424 | 0 | 1.573576 | 60 |
| 1 | 84568 | 4 | 15432 | 98417 | 4 | 01583 | 12450 | 4 | 87550 | 26662 | 4 | 73338 | 59 |
| 2 | 84797 | 8 | 15203 | 98650 | 8 | 01350 | 12685 | 8 | 87315 | 26900 | 8 | 73100 | 58 |
| 3 | 85026 | 12 | 14974 | 98882 | 12 | 01118 | 12921 | 12 | 87079 | 27139 | 12 | 72861 | 57 |
| 4 | 85256 | 16 | 14744 | 99115 | 16 | 00885 | 13156 | 16 | 86844 | 27377 | 16 | 72623 | 56 |
| 5 | 85485 | 19 | 14515 | 99347 | 19 | 00653 | 13392 | 20 | 86608 | 27616 | 20 | 72384 | 55 |
| 6 | 85715 | 23 | 14285 | 99580 | 23 | 00420 | 13628 | 24 | 86372 | 27854 | 24 | 72146 | 54 |
| 7 | 85944 | 27 | 14056 | 399812 | 27 | 1.600188 | 13863 | 28 | 86137 | 28093 | 28 | 71907 | 53 |
| 8 | 86174 | 31 | 13826 | 400045 | 31 | 1.599955 | 14099 | 32 | 85901 | 28331 | 32 | 71669 | 52 |
| 9 | 86404 | 35 | 13596 | 00278 | 35 | 99722 | 14335 | 36 | 85665 | 28570 | 36 | 71430 | 51 |
| 10 | 86633 | 38 | 13367 | 00511 | 39 | 99489 | 14571 | 39 | 85429 | 28809 | 40 | 71191 | 50 |
| 11 | 386863 | 42 | 1.613137 | 400744 | 43 | 1.599256 | 414806 | 43 | 1.585194 | 429048 | 44 | 1.570952 | 49 |
| 12 | 87093 | 46 | 12907 | 00976 | 47 | 99024 | 15042 | 47 | 84958 | 29286 | 48 | 70714 | 48 |
| 13 | 87323 | 50 | 12677 | 01209 | 50 | 98791 | 15278 | 51 | 84722 | 29525 | 52 | 70475 | 47 |
| 14 | 87553 | 54 | 12447 | 01442 | 54 | 98558 | 15514 | 55 | 84486 | 29764 | 56 | 70236 | 46 |
| 15 | 87783 | 57 | 12217 | 01675 | 58 | 98325 | 15750 | 59 | 84250 | 30003 | 60 | 69997 | 45 |
| 16 | 88013 | 61 | 11987 | 01908 | 62 | 98092 | 15986 | 63 | 84014 | 30242 | 64 | 69758 | 44 |
| 17 | 88243 | 65 | 11757 | 02142 | 66 | 97858 | 16223 | 67 | 83777 | 30481 | 68 | 69519 | 43 |
| 18 | 88473 | 69 | 11527 | 02375 | 70 | 97625 | 16459 | 71 | 83541 | 30720 | 72 | 69280 | 42 |
| 19 | 88703 | 73 | 11297 | 02608 | 74 | 97392 | 16695 | 75 | 83305 | 30960 | 76 | 69040 | 41 |
| 20 | 88933 | 77 | 11067 | 02841 | 78 | 97159 | 16931 | 79 | 83069 | 31199 | 80 | 68801 | 40 |
| 21 | 389164 | 81 | 1.610836 | 403075 | 82 | 1.596925 | 417168 | 83 | 1.582832 | 431438 | 84 | 1.568562 | 39 |
| 22 | 89394 | 85 | 10606 | 03308 | 86 | 96692 | 17404 | 87 | 82596 | 31677 | 88 | 68323 | 38 |
| 23 | 89624 | 89 | 10376 | 03542 | 90 | 96458 | 17640 | 91 | 82360 | 31917 | 92 | 68083 | 37 |
| 24 | 89855 | 92 | 10145 | 03775 | 94 | 96225 | 17877 | 95 | 82123 | 32156 | 96 | 67844 | 36 |
| 25 | 90085 | 96 | 09915 | 04009 | 98 | 95991 | 18114 | 99 | 81886 | 32396 | 100 | 67604 | 35 |
| 26 | 90316 | 100 | 09684 | 04242 | 102 | 95758 | 18350 | 103 | 81650 | 32635 | 104 | 67365 | 34 |
| 27 | 90546 | 104 | 09454 | 04476 | 106 | 95524 | 18587 | 107 | 81413 | 32875 | 108 | 67125 | 33 |
| 28 | 90777 | 108 | 09223 | 04710 | 110 | 95290 | 18824 | 111 | 81176 | 33114 | 112 | 66886 | 32 |
| 29 | 91008 | 111 | 08992 | 04943 | 114 | 95057 | 19060 | 115 | 80940 | 33354 | 116 | 66646 | 31 |
| 30 | 91239 | 115 | 08761 | 05177 | 117 | 94823 | 19297 | 118 | 80703 | 33594 | 120 | 66406 | 30 |
| 31 | 391469 | 119 | 1.608531 | 405411 | 121 | 1.594589 | 419534 | 122 | 1.580466 | 433834 | 124 | 1.566166 | 29 |
| 32 | 91700 | 123 | 08300 | 05645 | 125 | 94355 | 19771 | 126 | 80229 | 34073 | 128 | 65927 | 28 |
| 33 | 91931 | 127 | 08069 | 05879 | 129 | 94121 | 20008 | 130 | 79992 | 34313 | 132 | 65687 | 27 |
| 34 | 92162 | 131 | 07838 | 06113 | 133 | 93887 | 20245 | 134 | 79755 | 34553 | 136 | 65447 | 26 |
| 35 | 92393 | 135 | 07607 | 06347 | 137 | 93653 | 20482 | 138 | 79518 | 34793 | 140 | 65207 | 25 |
| 36 | 92624 | 139 | 07376 | 06581 | 141 | 93419 | 20719 | 142 | 79281 | 35033 | 144 | 64967 | 24 |
| 37 | 92855 | 143 | 07145 | 06815 | 145 | 93185 | 20956 | 146 | 79044 | 35273 | 148 | 64727 | 23 |
| 38 | 93086 | 147 | 06914 | 07049 | 149 | 92951 | 21193 | 150 | 78807 | 35513 | 152 | 64487 | 22 |
| 39 | 93318 | 151 | 06682 | 07284 | 153 | 92716 | 21430 | 154 | 78570 | 35753 | 156 | 64247 | 21 |
| 40 | 93549 | 154 | 06451 | 07518 | 156 | 92482 | 21668 | 158 | 78332 | 35993 | 160 | 64007 | 20 |
| 41 | 393780 | 158 | 1.606220 | 407752 | 160 | 1.592248 | 421905 | 162 | 1.578095 | 436234 | 164 | 1.563766 | 19 |
| 42 | 94012 | 162 | 05988 | 07987 | 164 | 92013 | 22142 | 166 | 77858 | 36474 | 168 | 63526 | 18 |
| 43 | 94243 | 166 | 05757 | 08221 | 168 | 91779 | 22380 | 170 | 77620 | 36714 | 172 | 63286 | 17 |
| 44 | 94474 | 170 | 05526 | 08456 | 172 | 91544 | 22617 | 174 | 77383 | 36955 | 176 | 63045 | 16 |
| 45 | 94706 | 174 | 05294 | 08690 | 176 | 91310 | 22855 | 178 | 77145 | 37195 | 180 | 62805 | 15 |
| 46 | 94938 | 178 | 05062 | 08925 | 180 | 91075 | 23092 | 182 | 76908 | 37436 | 184 | 62564 | 14 |
| 47 | 95169 | 182 | 04831 | 09160 | 184 | 90840 | 23330 | 186 | 76670 | 37676 | 188 | 62324 | 13 |
| 48 | 95401 | 186 | 04599 | 09394 | 188 | 90606 | 23568 | 190 | 76432 | 37917 | 192 | 62083 | 12 |
| 49 | 95633 | 190 | 04367 | 09629 | 192 | 90371 | 23805 | 194 | 76195 | 38157 | 196 | 61843 | 11 |
| 50 | 95864 | 194 | 04136 | 09864 | 195 | 90136 | 24043 | 198 | 75957 | 38398 | 200 | 61602 | 10 |
| 51 | 396096 | 197 | 1.603904 | 410099 | 199 | 1.589901 | 424281 | 202 | 1.575719 | 438639 | 204 | 1.561361 | 9 |
| 52 | 96328 | 201 | 03672 | 10334 | 203 | 89666 | 24519 | 206 | 75481 | 38879 | 208 | 61121 | 8 |
| 53 | 96560 | 205 | 03440 | 10569 | 207 | 89431 | 24757 | 210 | 75243 | 39120 | 212 | 60880 | 7 |
| 54 | 96792 | 209 | 03208 | 10804 | 211 | 89196 | 24995 | 214 | 75005 | 39361 | 216 | 60639 | 6 |
| 55 | 97024 | 213 | 02976 | 11039 | 215 | 88961 | 25233 | 218 | 74767 | 39602 | 220 | 60398 | 5 |
| 56 | 97256 | 217 | 02744 | 11274 | 219 | 88726 | 25471 | 222 | 74529 | 39843 | 224 | 60157 | 4 |
| 57 | 97488 | 220 | 02512 | 11509 | 223 | 88491 | 25709 | 226 | 74291 | 40084 | 228 | 59916 | 3 |
| 58 | 97720 | 224 | 02280 | 11744 | 227 | 88256 | 25947 | 230 | 74053 | 40325 | 232 | 59675 | 2 |
| 59 | 97953 | 228 | 02047 | 11979 | 231 | 88021 | 26185 | 234 | 73815 | 40566 | 236 | 59434 | 1 |
| 60 | 398185 | 231 | 1.601815 | 412215 | 234 | 1.587785 | 426424 | 237 | 1.573576 | 440807 | 240 | 1.559193 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 127° | | | 126° | | | 125° | | | 124° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 56° Versed. | Parts for ″ | Suvers. | 57° Versed. | Parts for ″ | Suvers. | 58° Versed. | Parts for ″ | Suvers. | 59° Versed. | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 440807 | 0 | 1.559193 | 455361 | 0 | 1.544639 | 470081 | 0 | 1.529919 | 484962 | 0 | 1.515038 | 60 |
| 1 | 41048 | 4 | 58952 | 55605 | 4 | 44395 | 70327 | 4 | 29673 | 85211 | 4 | 14789 | 59 |
| 2 | 41290 | 8 | 58710 | 55849 | 8 | 44151 | 70574 | 8 | 29426 | 85461 | 8 | 14539 | 58 |
| 3 | 41531 | 12 | 58469 | 56093 | 12 | 43907 | 70821 | 12 | 29179 | 85710 | 12 | 14290 | 57 |
| 4 | 41772 | 16 | 58228 | 56337 | 16 | 43663 | 71068 | 17 | 28932 | 85960 | 17 | 14040 | 56 |
| 5 | 42013 | 20 | 57987 | 56581 | 20 | 43419 | 71315 | 21 | 28685 | 86209 | 21 | 13791 | 55 |
| 6 | 42255 | 24 | 57745 | 56826 | 24 | 43174 | 71562 | 25 | 28438 | 86459 | 25 | 13541 | 54 |
| 7 | 42496 | 28 | 57504 | 57070 | 28 | 42930 | 71809 | 29 | 28191 | 86708 | 29 | 13292 | 53 |
| 8 | 42738 | 32 | 57262 | 57314 | 32 | 42686 | 72056 | 33 | 27944 | 86958 | 33 | 13042 | 52 |
| 9 | 42979 | 36 | 57021 | 57558 | 37 | 42442 | 72303 | 37 | 27697 | 87208 | 37 | 12792 | 51 |
| 10 | 43221 | 40 | 56779 | 57803 | 41 | 42197 | 72550 | 41 | 27450 | 87457 | 42 | 12543 | 50 |
| 11 | 443463 | 45 | 1.556537 | 458047 | 45 | 1.541953 | 472797 | 45 | 1.527203 | 487707 | 46 | 1.512293 | 49 |
| 12 | 43704 | 49 | 56296 | 58292 | 49 | 41708 | 73044 | 49 | 26956 | 87957 | 50 | 12043 | 48 |
| 13 | 43946 | 53 | 56054 | 58536 | 53 | 41464 | 73291 | 54 | 26709 | 88207 | 54 | 11793 | 47 |
| 14 | 44188 | 57 | 55812 | 58781 | 57 | 41219 | 73539 | 58 | 26461 | 88457 | 58 | 11543 | 46 |
| 15 | 44430 | 61 | 55570 | 59025 | 61 | 40975 | 73786 | 62 | 26214 | 88707 | 63 | 11293 | 45 |
| 16 | 44672 | 65 | 55328 | 59270 | 65 | 40730 | 74033 | 66 | 25967 | 88957 | 67 | 11043 | 44 |
| 17 | 44914 | 69 | 55086 | 59515 | 69 | 40485 | 74281 | 70 | 25719 | 89207 | 71 | 10793 | 43 |
| 18 | 45156 | 73 | 54844 | 59760 | 73 | 40240 | 74528 | 74 | 25472 | 89457 | 75 | 10543 | 42 |
| 19 | 45398 | 77 | 54602 | 60004 | 77 | 39996 | 74776 | 78 | 25224 | 89707 | 79 | 10293 | 41 |
| 20 | 45640 | 81 | 54360 | 60249 | 81 | 39751 | 75023 | 82 | 24977 | 89957 | 83 | 10043 | 40 |
| 21 | 445882 | 85 | 1.554118 | 460494 | 86 | 1.539506 | 475271 | 87 | 1.524729 | 490208 | 87 | 1.509792 | 39 |
| 22 | 46124 | 89 | 53876 | 60739 | 90 | 39261 | 75519 | 91 | 24481 | 90458 | 91 | 09542 | 38 |
| 23 | 46366 | 93 | 53634 | 60984 | 94 | 39016 | 75766 | 95 | 24234 | 90708 | 95 | 09292 | 37 |
| 24 | 46608 | 97 | 53392 | 61229 | 98 | 38771 | 76014 | 99 | 23986 | 90959 | 99 | 09041 | 36 |
| 25 | 46851 | 101 | 53149 | 61474 | 102 | 38526 | 76262 | 103 | 23738 | 91209 | 104 | 08791 | 35 |
| 26 | 47093 | 105 | 52907 | 61719 | 106 | 38281 | 76510 | 107 | 23490 | 91459 | 108 | 08541 | 34 |
| 27 | 47336 | 109 | 52664 | 61965 | 110 | 38035 | 76758 | 111 | 23242 | 91710 | 112 | 08290 | 33 |
| 28 | 47578 | 113 | 52422 | 62210 | 114 | 37790 | 77005 | 115 | 22995 | 91960 | 117 | 08040 | 32 |
| 29 | 47820 | 117 | 52180 | 62455 | 118 | 37545 | 77253 | 119 | 22747 | 92211 | 121 | 07789 | 31 |
| 30 | 48063 | 122 | 51937 | 62700 | 122 | 37300 | 77501 | 124 | 22499 | 92462 | 126 | 07538 | 30 |
| 31 | 448306 | 126 | 1.551694 | 462946 | 127 | 1.537054 | 477749 | 128 | 1.522251 | 492712 | 130 | 1.507288 | 29 |
| 32 | 48548 | 130 | 51452 | 63191 | 131 | 36809 | 77998 | 132 | 22002 | 92963 | 134 | 07037 | 28 |
| 33 | 48791 | 134 | 51209 | 63437 | 135 | 36563 | 78246 | 136 | 21754 | 93214 | 138 | 06786 | 27 |
| 34 | 49034 | 138 | 50966 | 63682 | 139 | 36318 | 78494 | 141 | 21506 | 93464 | 142 | 06536 | 26 |
| 35 | 49276 | 142 | 50724 | 63928 | 143 | 36072 | 78742 | 145 | 21258 | 93715 | 146 | 06285 | 25 |
| 36 | 49519 | 146 | 50481 | 64173 | 148 | 35827 | 78990 | 149 | 21010 | 93966 | 151 | 06034 | 24 |
| 37 | 49762 | 150 | 50238 | 64419 | 152 | 35581 | 79239 | 153 | 20761 | 94217 | 155 | 05783 | 23 |
| 38 | 50005 | 154 | 49995 | 64664 | 156 | 35336 | 79487 | 158 | 20513 | 94468 | 159 | 05532 | 22 |
| 39 | 50248 | 158 | 49752 | 64910 | 160 | 35090 | 79735 | 162 | 20265 | 94719 | 163 | 05281 | 21 |
| 40 | 50491 | 162 | 49509 | 65156 | 164 | 34844 | 79984 | 166 | 20016 | 94970 | 168 | 05030 | 20 |
| 41 | 450734 | 166 | 1.549266 | 465402 | 168 | 1.534598 | 480232 | 170 | 1.519768 | 495221 | 172 | 1.504779 | 19 |
| 42 | 50977 | 171 | 49023 | 65648 | 172 | 34352 | 80481 | 174 | 19519 | 95472 | 176 | 04528 | 18 |
| 43 | 51220 | 175 | 48780 | 65893 | 176 | 34107 | 80729 | 178 | 19271 | 95723 | 180 | 04277 | 17 |
| 44 | 51464 | 179 | 48536 | 66139 | 180 | 33861 | 80978 | 182 | 19022 | 95975 | 184 | 04025 | 16 |
| 45 | 51707 | 183 | 48293 | 66385 | 184 | 33615 | 81227 | 186 | 18773 | 96226 | 188 | 03774 | 15 |
| 46 | 51950 | 187 | 48050 | 66631 | 189 | 33369 | 81475 | 190 | 18525 | 96477 | 193 | 03523 | 14 |
| 47 | 52193 | 191 | 47807 | 66878 | 193 | 33122 | 81724 | 195 | 18276 | 96729 | 197 | 03271 | 13 |
| 48 | 52437 | 195 | 47563 | 67124 | 197 | 32876 | 81973 | 199 | 18027 | 96980 | 201 | 03020 | 12 |
| 49 | 52680 | 199 | 47320 | 67370 | 201 | 32630 | 82222 | 203 | 17778 | 97231 | 205 | 02769 | 11 |
| 50 | 52924 | 203 | 47076 | 67616 | 205 | 32384 | 82471 | 207 | 17529 | 97483 | 210 | 02517 | 10 |
| 51 | 453167 | 207 | 1.546833 | 467862 | 209 | 1.532138 | 482720 | 212 | 1.517280 | 497734 | 214 | 1.502266 | 9 |
| 52 | 53411 | 211 | 46589 | 68109 | 213 | 31891 | 82969 | 216 | 17031 | 97986 | 218 | 02014 | 8 |
| 53 | 53654 | 215 | 46346 | 68355 | 217 | 31645 | 83218 | 220 | 16782 | 98238 | 222 | 01762 | 7 |
| 54 | 53898 | 219 | 46102 | 68601 | 221 | 31399 | 83467 | 224 | 16533 | 98489 | 226 | 01511 | 6 |
| 55 | 54142 | 223 | 45858 | 68848 | 226 | 31152 | 83716 | 228 | 16284 | 98741 | 230 | 01259 | 5 |
| 56 | 54385 | 227 | 45615 | 69094 | 230 | 30906 | 83965 | 233 | 16035 | 98993 | 235 | 01007 | 4 |
| 57 | 54629 | 231 | 45371 | 69341 | 234 | 30659 | 84214 | 237 | 15786 | 99244 | 239 | 00756 | 3 |
| 58 | 54873 | 235 | 45127 | 69587 | 238 | 30413 | 84463 | 241 | 15537 | 99496 | 243 | 00504 | 2 |
| 59 | 55117 | 239 | 44883 | 69834 | 242 | 30166 | 84713 | 245 | 15287 | 99748 | 247 | 00252 | 1 |
| 60 | 455361 | 243 | 1.544639 | 470081 | 246 | 1.529919 | 484962 | 249 | 1.515038 | 500000 | 251 | 1.500000 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 123° | | | 122° | | | 121° | | | 120° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 60° Versed | Parts for ″ | Suvers. | 61° Versed | Parts for ″ | Suvers. | 62° Versed. | Parts for ″ | Suvers. | 63° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 500000 | 0 | 1.500000 | 515190 | 0 | 1.484810 | 530528 | 0 | 1.469472 | 546009 | 0 | 1.453991 | 60 |
| 1 | 00252 | 4 | 1.499748 | 15445 | 4 | 84555 | 30785 | 4 | 69215 | 46269 | 4 | 53731 | 59 |
| 2 | 00504 | 8 | 99496 | 15699 | 8 | 84301 | 31042 | 8 | 68958 | 46528 | 9 | 53472 | 58 |
| 3 | 00756 | 12 | 99244 | 15954 | 13 | 84046 | 31299 | 13 | 68701 | 46787 | 13 | 53213 | 57 |
| 4 | 01008 | 17 | 98992 | 16208 | 17 | 83792 | 31556 | 17 | 68444 | 47046 | 17 | 52954 | 56 |
| 5 | 01260 | 21 | 98740 | 16463 | 21 | 83537 | 31813 | 21 | 68187 | 47306 | 22 | 52694 | 55 |
| 6 | 01512 | 25 | 98488 | 16718 | 25 | 83282 | 32070 | 26 | 67930 | 47565 | 26 | 52435 | 54 |
| 7 | 01764 | 30 | 98236 | 16972 | 30 | 83028 | 32327 | 30 | 67673 | 47825 | 30 | 52175 | 53 |
| 8 | 02017 | 34 | 97983 | 17227 | 34 | 82773 | 32584 | 34 | 67416 | 48084 | 35 | 51916 | 52 |
| 9 | 02269 | 38 | 97731 | 17482 | 38 | 82518 | 32842 | 38 | 67158 | 48344 | 39 | 51656 | 51 |
| 10 | 02521 | 42 | 97479 | 17737 | 43 | 82263 | 33099 | 43 | 66901 | 48603 | 43 | 51397 | 50 |
| 11 | 502774 | 46 | 1.497226 | 517991 | 47 | 1.482009 | 533356 | 47 | 1.466644 | 548863 | 48 | 1.451137 | 49 |
| 12 | 03026 | 50 | 96974 | 18246 | 51 | 81754 | 33613 | 51 | 66387 | 49122 | 52 | 50878 | 48 |
| 13 | 03278 | 54 | 96722 | 18501 | 55 | 81499 | 33871 | 55 | 66129 | 49382 | 56 | 50618 | 47 |
| 14 | 03531 | 58 | 96469 | 18756 | 59 | 81244 | 34128 | 60 | 65872 | 49642 | 61 | 50358 | 46 |
| 15 | 03783 | 63 | 96217 | 19011 | 63 | 80989 | 34385 | 64 | 65615 | 49902 | 65 | 50098 | 45 |
| 16 | 04036 | 67 | 95964 | 19266 | 67 | 80734 | 34643 | 68 | 65357 | 50161 | 69 | 49839 | 44 |
| 17 | 04289 | 71 | 95711 | 19521 | 72 | 80479 | 34900 | 72 | 65100 | 50421 | 74 | 49579 | 43 |
| 18 | 04541 | 75 | 95459 | 19776 | 76 | 80224 | 35158 | 77 | 64842 | 50681 | 78 | 49319 | 42 |
| 19 | 04794 | 79 | 95206 | 20032 | 80 | 79968 | 35415 | 81 | 64585 | 50941 | 82 | 49059 | 41 |
| 20 | 05047 | 84 | 94953 | 20287 | 85 | 79713 | 35673 | 85 | 64327 | 51201 | 87 | 48799 | 40 |
| 21 | 505299 | 88 | 1.494701 | 520542 | 89 | 1.479458 | 535931 | 90 | 1.464069 | 551461 | 91 | 1.448539 | 39 |
| 22 | 05552 | 92 | 94448 | 20797 | 93 | 79203 | 36188 | 94 | 63812 | 51721 | 95 | 48279 | 38 |
| 23 | 05805 | 96 | 94195 | 21053 | 97 | 78947 | 36446 | 98 | 63554 | 51981 | 100 | 48019 | 37 |
| 24 | 06058 | 100 | 93942 | 21308 | 101 | 78692 | 36704 | 103 | 63296 | 52241 | 104 | 47759 | 36 |
| 25 | 06311 | 105 | 93689 | 21564 | 106 | 78436 | 36962 | 107 | 63038 | 52501 | 108 | 47499 | 35 |
| 26 | 06564 | 109 | 93436 | 21819 | 110 | 78181 | 37220 | 111 | 62780 | 52761 | 113 | 47239 | 34 |
| 27 | 06817 | 113 | 93183 | 22074 | 115 | 77926 | 37477 | 115 | 62523 | 53021 | 117 | 46979 | 33 |
| 28 | 07070 | 117 | 92930 | 22330 | 119 | 77670 | 37735 | 120 | 62265 | 53282 | 121 | 46718 | 32 |
| 29 | 07323 | 121 | 92677 | 22586 | 123 | 77414 | 37993 | 124 | 62007 | 53542 | 126 | 46458 | 31 |
| 30 | 07576 | 126 | 92424 | 22841 | 128 | 77159 | 38251 | 129 | 61749 | 53802 | 130 | 46198 | 30 |
| 31 | 507830 | 131 | 1.492170 | 523097 | 132 | 1.476903 | 538509 | 133 | 1.461491 | 554062 | 134 | 1.445938 | 29 |
| 32 | 08083 | 135 | 91917 | 23353 | 136 | 76647 | 38767 | 138 | 61233 | 54323 | 139 | 45677 | 28 |
| 33 | 08336 | 140 | 91664 | 23608 | 141 | 76392 | 39026 | 142 | 60974 | 54583 | 143 | 45417 | 27 |
| 34 | 08589 | 144 | 91411 | 23864 | 145 | 76136 | 39284 | 146 | 60716 | 54844 | 147 | 45156 | 26 |
| 35 | 08843 | 148 | 91157 | 24120 | 149 | 75880 | 39542 | 151 | 60458 | 55104 | 152 | 44896 | 25 |
| 36 | 09096 | 152 | 90904 | 24376 | 154 | 75624 | 39800 | 155 | 60200 | 55365 | 156 | 44635 | 24 |
| 37 | 09350 | 156 | 90650 | 24632 | 158 | 75368 | 40058 | 159 | 59942 | 55625 | 160 | 44375 | 23 |
| 38 | 09603 | 161 | 90397 | 24888 | 162 | 75112 | 40317 | 164 | 59683 | 55886 | 165 | 44114 | 22 |
| 39 | 09857 | 165 | 90143 | 25144 | 166 | 74856 | 40575 | 168 | 59425 | 56147 | 169 | 43853 | 21 |
| 40 | 10110 | 169 | 89890 | 25400 | 171 | 74600 | 40833 | 172 | 59167 | 56407 | 174 | 43593 | 20 |
| 41 | 510364 | 173 | 1.489636 | 525656 | 175 | 1.474344 | 541092 | 177 | 1.458908 | 556668 | 178 | 1.443332 | 19 |
| 42 | 10617 | 178 | 89383 | 25912 | 179 | 74088 | 41350 | 181 | 58650 | 56929 | 182 | 43071 | 18 |
| 43 | 10871 | 182 | 89129 | 26168 | 183 | 73832 | 41609 | 185 | 58391 | 57190 | 187 | 42810 | 17 |
| 44 | 11125 | 186 | 88875 | 26424 | 187 | 73576 | 41867 | 189 | 58133 | 57450 | 191 | 42550 | 16 |
| 45 | 11379 | 190 | 88621 | 26680 | 192 | 73320 | 42126 | 194 | 57874 | 57711 | 195 | 42289 | 15 |
| 46 | 11633 | 195 | 88367 | 26937 | 196 | 73063 | 42385 | 198 | 57615 | 57972 | 199 | 42028 | 14 |
| 47 | 11886 | 199 | 88114 | 27193 | 200 | 72807 | 42643 | 202 | 57357 | 58233 | 204 | 41767 | 13 |
| 48 | 12140 | 203 | 87860 | 27449 | 204 | 72551 | 42902 | 207 | 57098 | 58494 | 208 | 41506 | 12 |
| 49 | 12394 | 207 | 87606 | 27706 | 208 | 72294 | 43161 | 211 | 56839 | 58755 | 212 | 41245 | 11 |
| 50 | 12648 | 212 | 87352 | 27962 | 213 | 72038 | 43420 | 215 | 56580 | 59016 | 217 | 40984 | 10 |
| 51 | 512902 | 216 | 1.487098 | 528218 | 217 | 1.471782 | 543678 | 220 | 1.456322 | 559277 | 221 | 1.440723 | 9 |
| 52 | 13156 | 220 | 86844 | 28475 | 221 | 71525 | 43937 | 224 | 56063 | 59538 | 226 | 40462 | 8 |
| 53 | 13410 | 224 | 86590 | 28731 | 225 | 71269 | 44196 | 228 | 55804 | 59800 | 230 | 40200 | 7 |
| 54 | 13665 | 229 | 86335 | 28988 | 230 | 71012 | 44455 | 233 | 55545 | 60061 | 234 | 39939 | 6 |
| 55 | 13919 | 233 | 86081 | 29245 | 234 | 70755 | 44714 | 237 | 55286 | 60322 | 239 | 39678 | 5 |
| 56 | 14173 | 237 | 85827 | 29501 | 238 | 70499 | 44973 | 241 | 55027 | 60583 | 243 | 39417 | 4 |
| 57 | 14427 | 241 | 85573 | 29758 | 242 | 70242 | 45232 | 246 | 54768 | 60845 | 247 | 39155 | 3 |
| 58 | 14682 | 245 | 85318 | 30015 | 247 | 69985 | 45491 | 250 | 54509 | 61106 | 251 | 38894 | 2 |
| 59 | 14936 | 249 | 85064 | 30272 | 251 | 69728 | 45750 | 254 | 54250 | 61367 | 256 | 38633 | 1 |
| 60 | 515190 | 254 | 1.484810 | 530528 | 256 | 1.469472 | 546009 | 258 | 1.453991 | 561629 | 260 | 1.438371 | 0 |
| ″ Vers. | 119° Suvers. | Parts for ″ | Versed | 118° Suvers. | Parts for ″ | Versed | 117° Suvers. | Parts for ″ | Versed | 116° Suvers. | Parts for ″ | Versed | ′ ″ Suv. |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ | 64° | | | 65° | | | 66° | | | 67° | | | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ″ Vers. | Versed. | Parts for ″ | Suvers. | Versed. | Parts for ″ | Suvers. | Versed. | Parts for ″ | Suvers. | Versed. | Parts for ″ | Suvers. | ″ Suv. |
| 0 | 561629 | 0 | 1.438371 | 577382 | 0 | 1.422618 | 593263 | 0 | 1.406737 | 609269 | 0 | 1.390731 | 60 |
| 1 | 61890 | 4 | 38110 | 77645 | 4 | 22355 | 93529 | 4 | 06471 | 09537 | 4 | 90463 | 59 |
| 2 | 62152 | 9 | 37848 | 77909 | 9 | 22091 | 93795 | 9 | 06205 | 09804 | 9 | 90196 | 58 |
| 3 | 62413 | 13 | 37587 | 78173 | 13 | 21827 | 94061 | 13 | 05939 | 10072 | 13 | 89928 | 57 |
| 4 | 62675 | 17 | 37325 | 78437 | 18 | 21563 | 94327 | 18 | 05673 | 10340 | 18 | 89660 | 56 |
| 5 | 62937 | 22 | 37063 | 78700 | 22 | 21300 | 94592 | 22 | 05408 | 10608 | 22 | 89392 | 55 |
| 6 | 63198 | 26 | 36802 | 78964 | 26 | 21036 | 94858 | 27 | 05142 | 10876 | 27 | 89124 | 54 |
| 7 | 63460 | 31 | 36540 | 79228 | 31 | 20772 | 95124 | 31 | 04876 | 11144 | 31 | 88856 | 53 |
| 8 | 63722 | 35 | 36278 | 79492 | 35 | 20508 | 95390 | 36 | 04610 | 11412 | 36 | 88588 | 52 |
| 9 | 63983 | 39 | 36017 | 79756 | 40 | 20244 | 95656 | 40 | 04344 | 11680 | 40 | 88320 | 51 |
| 10 | 64245 | 44 | 35755 | 80020 | 44 | 19980 | 95922 | 44 | 04078 | 11948 | 45 | 88052 | 50 |
| 11 | 564507 | 48 | 1.435493 | 580284 | 48 | 1.419716 | 596189 | 49 | 1.403811 | 612216 | 49 | 1.387784 | 49 |
| 12 | 64769 | 52 | 35231 | 80548 | 53 | 19452 | 96455 | 53 | 03545 | 12484 | 54 | 87516 | 48 |
| 13 | 65031 | 57 | 34969 | 80812 | 57 | 19188 | 96721 | 58 | 03279 | 12753 | 58 | 87247 | 47 |
| 14 | 65293 | 61 | 34707 | 81076 | 62 | 18924 | 96987 | 62 | 03013 | 13021 | 63 | 86979 | 46 |
| 15 | 65555 | 66 | 34445 | 81340 | 66 | 18660 | 97253 | 66 | 02747 | 13289 | 67 | 86711 | 45 |
| 16 | 65817 | 70 | 34183 | 81604 | 71 | 18396 | 97520 | 71 | 02480 | 13557 | 72 | 86443 | 44 |
| 17 | 66079 | 74 | 33921 | 81869 | 75 | 18131 | 97786 | 76 | 02214 | 13826 | 76 | 86174 | 43 |
| 18 | 66341 | 79 | 33659 | 82133 | 79 | 17867 | 98052 | 80 | 01948 | 14094 | 81 | 85906 | 42 |
| 19 | 66603 | 83 | 33397 | 82397 | 84 | 17603 | 98319 | 85 | 01681 | 14362 | 85 | 85638 | 41 |
| 20 | 66865 | 87 | 33135 | 82661 | 88 | 17339 | 98585 | 89 | 01415 | 14631 | 89 | 85369 | 40 |
| 21 | 567127 | 92 | 1.432873 | 582926 | 92 | 1.417074 | 598851 | 94 | 1.401149 | 614899 | 93 | 1.385101 | 39 |
| 22 | 67390 | 96 | 32610 | 83190 | 97 | 16810 | 99118 | 98 | 00882 | 15168 | 98 | 84832 | 38 |
| 23 | 67652 | 100 | 32348 | 83455 | 101 | 16545 | 99384 | 103 | 00616 | 15436 | 102 | 84564 | 37 |
| 24 | 67914 | 105 | 32086 | 83719 | 106 | 16281 | 99651 | 107 | 00349 | 15705 | 107 | 84295 | 36 |
| 25 | 68177 | 109 | 31823 | 83984 | 110 | 16016 | 99917 | 112 | 1.400083 | 15973 | 111 | 84027 | 35 |
| 26 | 68439 | 113 | 31561 | 84248 | 114 | 15752 | 600184 | 116 | 1.399816 | 16242 | 116 | 83758 | 34 |
| 27 | 68701 | 118 | 31299 | 84513 | 119 | 15487 | 00451 | 121 | 99549 | 16510 | 121 | 83490 | 33 |
| 28 | 68964 | 122 | 31036 | 84777 | 123 | 15223 | 00717 | 125 | 99283 | 16779 | 125 | 83221 | 32 |
| 29 | 69226 | 126 | 30774 | 85042 | 128 | 14958 | 00984 | 129 | 99016 | 17048 | 130 | 82952 | 31 |
| 30 | 69489 | 131 | 30511 | 85307 | 132 | 14693 | 01251 | 133 | 98749 | 17317 | 134 | 82683 | 30 |
| 31 | 569751 | 136 | 1.430249 | 585571 | 137 | 1.414429 | 601518 | 138 | 1.398482 | 617585 | 139 | 1.382415 | 29 |
| 32 | 70014 | 140 | 29986 | 85836 | 141 | 14164 | 01784 | 142 | 98216 | 17854 | 143 | 82146 | 28 |
| 33 | 70277 | 145 | 29723 | 86101 | 146 | 13899 | 02051 | 147 | 97949 | 18123 | 148 | 81877 | 27 |
| 34 | 70539 | 149 | 29461 | 86366 | 150 | 13634 | 02318 | 151 | 97682 | 18392 | 152 | 81608 | 26 |
| 35 | 70802 | 153 | 29198 | 86631 | 154 | 13369 | 02585 | 156 | 97415 | 18661 | 157 | 81339 | 25 |
| 36 | 71065 | 158 | 28935 | 86896 | 159 | 13104 | 02852 | 160 | 97148 | 18930 | 161 | 81070 | 24 |
| 37 | 71328 | 162 | 28672 | 87160 | 163 | 12840 | 03119 | 165 | 96881 | 19199 | 166 | 80801 | 23 |
| 38 | 71590 | 167 | 28410 | 87425 | 168 | 12575 | 03386 | 169 | 96614 | 19468 | 170 | 80532 | 22 |
| 39 | 71853 | 171 | 28147 | 87690 | 172 | 12310 | 03653 | 174 | 96347 | 19737 | 175 | 80263 | 21 |
| 40 | 72116 | 175 | 27884 | 87955 | 177 | 12045 | 03920 | 178 | 96080 | 20006 | 179 | 79994 | 20 |
| 41 | 572379 | 180 | 1.427621 | 588220 | 181 | 1.411780 | 604187 | 182 | 1.395813 | 620275 | 184 | 1.379725 | 19 |
| 42 | 72642 | 184 | 27358 | 88486 | 185 | 11514 | 04454 | 187 | 95546 | 20544 | 188 | 79456 | 18 |
| 43 | 72905 | 189 | 27095 | 88751 | 189 | 11249 | 04722 | 191 | 95278 | 20813 | 193 | 79187 | 17 |
| 44 | 73168 | 193 | 26832 | 89016 | 194 | 10984 | 04989 | 196 | 95011 | 21082 | 197 | 78918 | 16 |
| 45 | 73431 | 197 | 26569 | 89281 | 199 | 10719 | 05256 | 200 | 94744 | 21351 | 202 | 78649 | 15 |
| 46 | 73694 | 202 | 26306 | 89546 | 203 | 10454 | 05523 | 205 | 94477 | 21621 | 206 | 78379 | 14 |
| 47 | 73957 | 206 | 26043 | 89812 | 207 | 10188 | 05791 | 209 | 94209 | 21890 | 211 | 78110 | 13 |
| 48 | 74221 | 210 | 25779 | 90077 | 212 | 09923 | 06058 | 214 | 93942 | 22159 | 215 | 77841 | 12 |
| 49 | 74484 | 215 | 25516 | 90342 | 216 | 09658 | 06325 | 218 | 93675 | 22429 | 220 | 77571 | 11 |
| 50 | 74747 | 219 | 25253 | 90608 | 221 | 09392 | 06593 | 223 | 93407 | 22698 | 224 | 77302 | 10 |
| 51 | 575010 | 224 | 1.424990 | 590873 | 225 | 1.409127 | 606860 | 227 | 1.393140 | 622967 | 229 | 1.377033 | 9 |
| 52 | 75274 | 228 | 24726 | 91138 | 230 | 08862 | 07128 | 231 | 92872 | 23237 | 233 | 76763 | 8 |
| 53 | 75537 | 232 | 24463 | 91404 | 234 | 08596 | 07395 | 236 | 92605 | 23506 | 238 | 76494 | 7 |
| 54 | 75801 | 237 | 24199 | 91669 | 239 | 08331 | 07663 | 240 | 92337 | 23776 | 242 | 76224 | 6 |
| 55 | 76064 | 241 | 23936 | 91935 | 243 | 08065 | 07930 | 245 | 92070 | 24045 | 247 | 75955 | 5 |
| 56 | 76327 | 245 | 23673 | 92201 | 247 | 07799 | 08198 | 249 | 91802 | 24315 | 251 | 75685 | 4 |
| 57 | 76591 | 250 | 23409 | 92466 | 252 | 07534 | 08466 | 254 | 91534 | 24584 | 256 | 75416 | 3 |
| 58 | 76854 | 254 | 23146 | 92732 | 256 | 07268 | 08733 | 258 | 91267 | 24854 | 260 | 75146 | 2 |
| 59 | 77118 | 259 | 22882 | 92998 | 260 | 07002 | 09001 | 263 | 90999 | 25124 | 265 | 74876 | 1 |
| 60 | 577382 | 263 | 1.422618 | 593263 | 265 | 1.406737 | 609269 | 267 | 1.390731 | 625393 | 269 | 1.374607 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 115° | | | 114° | | | 113° | | | 112° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 68° Versed | Parts for ″ | Suvers. | 69° Versed | Parts for ″ | Suvers. | 70° Versed | Parts for ″ | Suvers. | 71° Versed | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 625393 | 0 | 1.374607 | 641632 | 0 | 1.358368 | 657980 | 0 | 1.342020 | 674432 | 0 | 1.325568 | 60 |
| 1 | 25663 | 5 | 74337 | 41904 | 5 | 58096 | 58253 | 5 | 41747 | 74707 | 5 | 25293 | 59 |
| 2 | 25933 | 9 | 74067 | 42175 | 9 | 57825 | 58527 | 9 | 41473 | 74982 | 9 | 25018 | 58 |
| 3 | 26203 | 14 | 73797 | 42447 | 14 | 57553 | 58800 | 14 | 41200 | 75257 | 14 | 24743 | 57 |
| 4 | 26472 | 18 | 73528 | 42719 | 18 | 57281 | 59073 | 18 | 40927 | 75532 | 18 | 24468 | 56 |
| 5 | 26742 | 23 | 73258 | 42990 | 23 | 57010 | 59347 | 23 | 40653 | 75807 | 23 | 24193 | 55 |
| 6 | 27012 | 27 | 72988 | 43262 | 27 | 56738 | 59620 | 27 | 40380 | 76083 | 27 | 23917 | 54 |
| 7 | 27282 | 32 | 72718 | 43534 | 32 | 56466 | 59894 | 32 | 40106 | 76358 | 32 | 23642 | 53 |
| 8 | 27552 | 36 | 72448 | 43806 | 36 | 56194 | 60167 | 36 | 39833 | 76633 | 37 | 23367 | 52 |
| 9 | 27822 | 41 | 72178 | 44077 | 41 | 55923 | 60441 | 41 | 39559 | 76908 | 41 | 23092 | 51 |
| 10 | 28092 | 45 | 71908 | 44349 | 46 | 55651 | 60715 | 46 | 39285 | 77184 | 46 | 22816 | 50 |
| 11 | 628362 | 50 | 1.371638 | 644621 | 50 | 1.355379 | 660988 | 50 | 1.339012 | 677459 | 51 | 1.322541 | 49 |
| 12 | 28632 | 54 | 71368 | 44893 | 54 | 55107 | 61262 | 55 | 38738 | 77734 | 55 | 22266 | 48 |
| 13 | 28902 | 59 | 71098 | 45165 | 59 | 54835 | 61536 | 59 | 38464 | 78010 | 60 | 21990 | 47 |
| 14 | 29172 | 63 | 70828 | 45437 | 63 | 54563 | 61809 | 64 | 38191 | 78285 | 64 | 21715 | 46 |
| 15 | 29443 | 68 | 70557 | 45709 | 68 | 54291 | 62083 | 68 | 37917 | 78560 | 69 | 21440 | 45 |
| 16 | 29713 | 72 | 70287 | 45981 | 73 | 54019 | 62357 | 73 | 37643 | 78836 | 74 | 21164 | 44 |
| 17 | 29983 | 77 | 70017 | 46253 | 77 | 53747 | 62631 | 78 | 37369 | 79111 | 78 | 20889 | 43 |
| 18 | 30253 | 81 | 69747 | 46525 | 82 | 53475 | 62905 | 82 | 37095 | 79387 | 83 | 20613 | 42 |
| 19 | 30523 | 86 | 69477 | 46797 | 87 | 53203 | 63179 | 87 | 36821 | 79663 | 87 | 20337 | 41 |
| 20 | 30794 | 90 | 69206 | 47069 | 91 | 52931 | 63452 | 91 | 36548 | 79938 | 92 | 20062 | 40 |
| 21 | 631064 | 95 | 1.368936 | 647342 | 96 | 1.352658 | 663726 | 96 | 1.336274 | 680214 | 96 | 1.319786 | 39 |
| 22 | 31335 | 100 | 68665 | 47614 | 100 | 52386 | 64000 | 100 | 36000 | 80489 | 101 | 19511 | 38 |
| 23 | 31605 | 104 | 68395 | 47886 | 105 | 52114 | 64274 | 105 | 35726 | 80765 | 106 | 19235 | 37 |
| 24 | 31875 | 108 | 68125 | 48158 | 109 | 51842 | 64548 | 109 | 35452 | 81041 | 110 | 18959 | 36 |
| 25 | 32146 | 113 | 67854 | 48431 | 114 | 51569 | 64822 | 114 | 35178 | 81316 | 115 | 18684 | 35 |
| 26 | 32416 | 117 | 67584 | 48703 | 118 | 51297 | 65097 | 118 | 34903 | 81592 | 119 | 18408 | 34 |
| 27 | 32687 | 122 | 67313 | 48975 | 123 | 51025 | 65371 | 123 | 34629 | 81868 | 124 | 18132 | 33 |
| 28 | 32957 | 126 | 67043 | 49248 | 127 | 50752 | 65645 | 127 | 34355 | 82144 | 128 | 17856 | 32 |
| 29 | 33228 | 131 | 66772 | 49520 | 132 | 50480 | 65919 | 132 | 34081 | 82419 | 133 | 17581 | 31 |
| 30 | 33499 | 135 | 66501 | 49793 | 136 | 50207 | 66193 | 137 | 33807 | 82695 | 138 | 17305 | 30 |
| 31 | 633769 | 140 | 1.366231 | 650065 | 141 | 1.349935 | 666467 | 142 | 1.333533 | 682971 | 143 | 1.317029 | 29 |
| 32 | 34040 | 144 | 65960 | 50338 | 145 | 49662 | 66742 | 146 | 33258 | 83247 | 147 | 16753 | 28 |
| 33 | 34311 | 149 | 65689 | 50610 | 150 | 49390 | 67016 | 151 | 32984 | 83523 | 152 | 16477 | 27 |
| 34 | 34582 | 153 | 65418 | 50883 | 155 | 49117 | 67290 | 155 | 32710 | 83799 | 157 | 16201 | 26 |
| 35 | 34852 | 158 | 65148 | 51155 | 159 | 48845 | 67564 | 160 | 32436 | 84075 | 161 | 15925 | 25 |
| 36 | 35123 | 162 | 64877 | 51428 | 164 | 48572 | 67839 | 165 | 32161 | 84351 | 166 | 15649 | 24 |
| 37 | 35394 | 167 | 64606 | 51701 | 168 | 48299 | 68113 | 169 | 31887 | 84627 | 171 | 15373 | 23 |
| 38 | 35665 | 171 | 64335 | 51973 | 173 | 48027 | 68388 | 173 | 31612 | 84903 | 175 | 15097 | 22 |
| 39 | 35936 | 176 | 64064 | 52246 | 177 | 47754 | 68662 | 178 | 31338 | 85179 | 180 | 14821 | 21 |
| 40 | 36207 | 180 | 63793 | 52519 | 182 | 47481 | 68937 | 183 | 31063 | 85455 | 184 | 14545 | 20 |
| 41 | 636478 | 185 | 1.363522 | 652791 | 186 | 1.347209 | 669211 | 187 | 1.330789 | 685731 | 189 | 1.314269 | 19 |
| 42 | 36749 | 189 | 63251 | 53064 | 191 | 46936 | 69486 | 192 | 30514 | 86007 | 193 | 13993 | 18 |
| 43 | 37020 | 194 | 62980 | 53337 | 195 | 46663 | 69760 | 197 | 30240 | 86284 | 198 | 13716 | 17 |
| 44 | 37291 | 198 | 62709 | 53610 | 200 | 46390 | 70035 | 201 | 29965 | 86560 | 202 | 13440 | 16 |
| 45 | 37562 | 203 | 62438 | 53883 | 205 | 46117 | 70309 | 206 | 29691 | 86836 | 207 | 13164 | 15 |
| 46 | 37833 | 207 | 62167 | 54156 | 209 | 45844 | 70584 | 210 | 29416 | 87112 | 212 | 12888 | 14 |
| 47 | 38104 | 212 | 61896 | 54429 | 214 | 45571 | 70859 | 215 | 29141 | 87389 | 216 | 12611 | 13 |
| 48 | 38375 | 216 | 61625 | 54702 | 218 | 45298 | 71133 | 220 | 28867 | 87665 | 221 | 12335 | 12 |
| 49 | 38647 | 221 | 61353 | 54975 | 223 | 45025 | 71408 | 224 | 28592 | 87941 | 225 | 12059 | 11 |
| 50 | 38918 | 226 | 61082 | 55248 | 228 | 44752 | 71683 | 229 | 28317 | 88218 | 230 | 11782 | 10 |
| 51 | 639189 | 230 | 1.360811 | 655521 | 232 | 1.344479 | 671958 | 234 | 1.328042 | 688494 | 235 | 1.311506 | 9 |
| 52 | 39460 | 235 | 60540 | 55794 | 237 | 44206 | 72232 | 238 | 27768 | 88771 | 239 | 11229 | 8 |
| 53 | 39732 | 239 | 60268 | 56067 | 241 | 43933 | 72507 | 243 | 27493 | 89047 | 244 | 10953 | 7 |
| 54 | 40003 | 244 | 59997 | 56340 | 246 | 43660 | 72782 | 247 | 27218 | 89324 | 248 | 10676 | 6 |
| 55 | 40275 | 248 | 59725 | 56613 | 250 | 43387 | 73057 | 252 | 26943 | 89600 | 253 | 10400 | 5 |
| 56 | 40546 | 253 | 59454 | 56887 | 255 | 43113 | 73332 | 256 | 26668 | 89877 | 258 | 10123 | 4 |
| 57 | 40817 | 257 | 59183 | 57160 | 259 | 42840 | 73607 | 261 | 26393 | 90153 | 262 | 09847 | 3 |
| 58 | 41089 | 262 | 58911 | 57433 | 264 | 42567 | 73882 | 265 | 26118 | 90430 | 267 | 09570 | 2 |
| 59 | 41360 | 266 | 58640 | 57706 | 268 | 42294 | 74157 | 270 | 25843 | 90706 | 271 | 09294 | 1 |
| 60 | 641632 | 271 | 1.358368 | 657980 | 273 | 1.342020 | 674432 | 274 | 1.325568 | 690983 | 276 | 1.309017 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 111° | | | 110° | | | 109° | | | 108° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 72° Versed | Parts for ″ | Suvers. | 73° Versed | Parts for ″ | Suvers. | 74° Versed | Parts for ″ | Suvers. | 75° Versed | Parts for ″ | Suvers. | ′ ″ Sun. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 690983 | 0 | 1.309017 | 707628 | 0 | 1.292372 | 724363 | 0 | 1.275637 | 741181 | 0 | 1.258819 | 60 |
| 1 | 91260 | 5 | 08740 | 07906 | 5 | 92094 | 24642 | 5 | 75358 | 41462 | 5 | 58538 | 59 |
| 2 | 91536 | 9 | 08464 | 08185 | 9 | 91815 | 24922 | 9 | 75078 | 41743 | 9 | 58257 | 58 |
| 3 | 91813 | 14 | 08187 | 08463 | 14 | 91537 | 25202 | 14 | 74798 | 42024 | 14 | 57976 | 57 |
| 4 | 92090 | 18 | 07910 | 08741 | 19 | 91259 | 25481 | 19 | 74519 | 42305 | 19 | 57695 | 56 |
| 5 | 92367 | 23 | 07633 | 09019 | 23 | 90981 | 25761 | 23 | 74239 | 42586 | 23 | 57414 | 55 |
| 6 | 92643 | 28 | 07357 | 09298 | 28 | 90702 | 26041 | 28 | 73959 | 42867 | 28 | 57133 | 54 |
| 7 | 92920 | 32 | 07080 | 09576 | 32 | 90424 | 26321 | 33 | 73679 | 43148 | 33 | 56852 | 53 |
| 8 | 93197 | 37 | 06803 | 09854 | 37 | 90146 | 26600 | 37 | 73400 | 43429 | 37 | 56571 | 52 |
| 9 | 93474 | 42 | 06526 | 10133 | 42 | 89867 | 26880 | 42 | 73120 | 43711 | 42 | 56289 | 51 |
| 10 | 93751 | 46 | 06249 | 10411 | 46 | 89589 | 27160 | 47 | 72840 | 43992 | 47 | 56008 | 50 |
| 11 | 694028 | 51 | 1.305972 | 710690 | 51 | 1.289310 | 727440 | 51 | 1.272560 | 744273 | 52 | 1.255727 | 49 |
| 12 | 94305 | 55 | 05695 | 10968 | 56 | 89032 | 27720 | 56 | 72280 | 44554 | 56 | 55446 | 48 |
| 13 | 94582 | 60 | 05418 | 11247 | 60 | 88753 | 28000 | 61 | 72000 | 44835 | 61 | 55165 | 47 |
| 14 | 94859 | 65 | 05141 | 11525 | 65 | 88475 | 28280 | 65 | 71720 | 45117 | 66 | 54883 | 46 |
| 15 | 95136 | 69 | 04864 | 11804 | 70 | 88196 | 28560 | 70 | 71440 | 45398 | 70 | 54602 | 45 |
| 16 | 95413 | 74 | 04587 | 12082 | 74 | 87918 | 28839 | 75 | 71161 | 45679 | 75 | 54321 | 44 |
| 17 | 95690 | 78 | 04310 | 12361 | 79 | 87639 | 29119 | 79 | 70881 | 45961 | 80 | 54039 | 43 |
| 18 | 95967 | 83 | 04033 | 12639 | 84 | 87361 | 29400 | 84 | 70600 | 46242 | 84 | 53758 | 42 |
| 19 | 96244 | 88 | 03756 | 12918 | 88 | 87082 | 29680 | 89 | 70320 | 46523 | 89 | 53477 | 41 |
| 20 | 96521 | 92 | 03479 | 13197 | 93 | 86803 | 29960 | 93 | 70040 | 46805 | 94 | 53195 | 40 |
| 21 | 696798 | 97 | 1.303202 | 713475 | 98 | 1.286525 | 730240 | 98 | 1.269760 | 747086 | 98 | 1.252914 | 39 |
| 22 | 97076 | 102 | 02924 | 13754 | 102 | 86246 | 30520 | 103 | 69480 | 47368 | 103 | 52632 | 38 |
| 23 | 97353 | 106 | 02647 | 14033 | 107 | 85967 | 30800 | 107 | 69200 | 47649 | 108 | 52351 | 37 |
| 24 | 97630 | 111 | 02370 | 14312 | 112 | 85688 | 31080 | 112 | 68920 | 47931 | 113 | 52069 | 36 |
| 25 | 97907 | 116 | 02093 | 14590 | 116 | 85410 | 31360 | 117 | 68640 | 48212 | 117 | 51788 | 35 |
| 26 | 98185 | 120 | 01815 | 14869 | 121 | 85131 | 31641 | 121 | 68359 | 48494 | 122 | 51506 | 34 |
| 27 | 98462 | 125 | 01538 | 15148 | 126 | 84852 | 31921 | 126 | 68079 | 48775 | 127 | 51225 | 33 |
| 28 | 98739 | 130 | 01261 | 15427 | 130 | 84573 | 32201 | 131 | 67799 | 49057 | 131 | 50943 | 32 |
| 29 | 99017 | 134 | 00983 | 15706 | 135 | 84294 | 32481 | 135 | 67519 | 49338 | 136 | 50662 | 31 |
| 30 | 99294 | 139 | 00706 | 15985 | 139 | 84015 | 32762 | 140 | 67238 | 49620 | 141 | 50380 | 30 |
| 31 | 699572 | 143 | 1.300428 | 716264 | 144 | 1.283736 | 733042 | 145 | 1.266958 | 749902 | 146 | 1.250098 | 29 |
| 32 | 699849 | 148 | 1.300151 | 16542 | 149 | 83458 | 33322 | 150 | 66678 | 50183 | 150 | 49817 | 28 |
| 33 | 700127 | 153 | 1.299873 | 16821 | 154 | 83179 | 33603 | 154 | 66397 | 50465 | 155 | 49535 | 27 |
| 34 | 00404 | 157 | 99596 | 17100 | 158 | 82900 | 33883 | 159 | 66117 | 50747 | 160 | 49253 | 26 |
| 35 | 00682 | 162 | 99318 | 17379 | 163 | 82621 | 34163 | 164 | 65837 | 51028 | 165 | 48972 | 25 |
| 36 | 00959 | 167 | 99041 | 17658 | 168 | 82342 | 34444 | 169 | 65556 | 51310 | 169 | 48690 | 24 |
| 37 | 01237 | 171 | 98763 | 17938 | 172 | 82062 | 34724 | 173 | 65276 | 51592 | 174 | 48408 | 23 |
| 38 | 01514 | 176 | 98486 | 18217 | 177 | 81783 | 35005 | 178 | 64995 | 51874 | 179 | 48126 | 22 |
| 39 | 01792 | 181 | 98208 | 18496 | 182 | 81504 | 35285 | 183 | 64715 | 52155 | 183 | 47845 | 21 |
| 40 | 02070 | 185 | 97930 | 18775 | 186 | 81225 | 35566 | 187 | 64434 | 52437 | 188 | 47563 | 20 |
| 41 | 702347 | 190 | 1.297653 | 719054 | 191 | 1.280946 | 735846 | 192 | 1.264154 | 752719 | 193 | 1.247281 | 19 |
| 42 | 02625 | 195 | 97375 | 19333 | 196 | 80667 | 36127 | 197 | 63873 | 53001 | 198 | 46999 | 18 |
| 43 | 02903 | 199 | 97097 | 19612 | 200 | 80388 | 36407 | 201 | 63593 | 53283 | 202 | 46717 | 17 |
| 44 | 03181 | 204 | 96819 | 19892 | 205 | 80108 | 36688 | 206 | 63312 | 53565 | 207 | 46435 | 16 |
| 45 | 03458 | 208 | 96542 | 20171 | 210 | 79829 | 36969 | 211 | 63031 | 53847 | 212 | 46153 | 15 |
| 46 | 03736 | 213 | 96264 | 20450 | 214 | 79550 | 37249 | 215 | 62751 | 54129 | 216 | 45871 | 14 |
| 47 | 04014 | 218 | 95986 | 20730 | 219 | 79270 | 37530 | 220 | 62470 | 54411 | 221 | 45589 | 13 |
| 48 | 04292 | 222 | 95708 | 21009 | 224 | 78991 | 37811 | 225 | 62189 | 54693 | 225 | 45307 | 12 |
| 49 | 04570 | 227 | 95430 | 21288 | 228 | 78712 | 38091 | 230 | 61909 | 54975 | 230 | 45025 | 11 |
| 50 | 04848 | 231 | 95152 | 21568 | 233 | 78432 | 38372 | 234 | 61628 | 55257 | 235 | 44743 | 10 |
| 51 | 705126 | 236 | 1.294874 | 721847 | 238 | 1.278153 | 738653 | 239 | 1.261347 | 755539 | 240 | 1.244461 | 9 |
| 52 | 05404 | 241 | 94596 | 22126 | 242 | 77874 | 38934 | 244 | 61066 | 55821 | 245 | 44179 | 8 |
| 53 | 05682 | 245 | 94318 | 22406 | 247 | 77594 | 39215 | 248 | 60785 | 56103 | 249 | 43897 | 7 |
| 54 | 05960 | 250 | 94040 | 22685 | 252 | 77315 | 39495 | 253 | 60505 | 56385 | 254 | 43615 | 6 |
| 55 | 06238 | 254 | 93762 | 22965 | 256 | 77035 | 39776 | 258 | 60224 | 56667 | 259 | 43333 | 5 |
| 56 | 06516 | 259 | 93484 | 23244 | 261 | 76756 | 40057 | 262 | 59943 | 56949 | 263 | 43051 | 4 |
| 57 | 06794 | 264 | 93206 | 23524 | 266 | 76476 | 40338 | 267 | 59662 | 57231 | 268 | 42769 | 3 |
| 58 | 07072 | 268 | 92928 | 23803 | 270 | 76197 | 40619 | 272 | 59381 | 57514 | 273 | 42486 | 2 |
| 59 | 07350 | 273 | 92650 | 24083 | 275 | 75917 | 40900 | 276 | 59100 | 57796 | 277 | 42204 | 1 |
| 60 | 707628 | 277 | 1.292372 | 724363 | 279 | 1.275637 | 741181 | 281 | 1.258819 | 758078 | 282 | 1.241922 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Sun. |
| | 107° | | | 106° | | | 105° | | | 104° | | | |

## Natural Versed and Suversed Sines.

| ′ | 76° | | | 77° | | | 78° | | | 79° | | | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ″ Vers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | Versed | Parts for ″ | Suvers. | ″ Suv. |
| 0 | 758078 | 0 | 1·241922 | 775049 | 0 | 1·224951 | 792088 | 0 | 1·207912 | 809191 | 0 | 1·190809 | 60 |
| 1 | 58360 | 5 | 41640 | 75332 | 5 | 24668 | 92373 | 5 | 07627 | 09477 | 5 | 90523 | 59 |
| 2 | 58643 | 9 | 41357 | 75616 | 9 | 24384 | 92657 | 9 | 07343 | 09762 | 10 | 90238 | 58 |
| 3 | 58925 | 14 | 41075 | 75899 | 14 | 24101 | 92942 | 14 | 07058 | 10048 | 14 | 89952 | 57 |
| 4 | 59207 | 19 | 40793 | 76183 | 19 | 23817 | 93227 | 19 | 06773 | 10333 | 19 | 89667 | 56 |
| 5 | 59490 | 24 | 40510 | 76466 | 24 | 23534 | 93511 | 24 | 06489 | 10619 | 24 | 89381 | 55 |
| 6 | 59772 | 28 | 40228 | 76750 | 28 | 23250 | 93796 | 28 | 06204 | 10905 | 29 | 89095 | 54 |
| 7 | 60054 | 33 | 39946 | 77033 | 33 | 22967 | 94080 | 33 | 05920 | 11190 | 33 | 88810 | 53 |
| 8 | 60337 | 38 | 39663 | 77317 | 38 | 22683 | 94365 | 38 | 05635 | 11476 | 38 | 88524 | 52 |
| 9 | 60619 | 43 | 39381 | 77601 | 43 | 22399 | 94650 | 43 | 05350 | 11761 | 43 | 88239 | 51 |
| 10 | 60902 | 47 | 39098 | 77884 | 47 | 22116 | 94934 | 47 | 05066 | 12047 | 48 | 87953 | 50 |
| 11 | 761184 | 52 | 1·238816 | 778168 | 52 | 1·221832 | 795219 | 52 | 1·204781 | 812333 | 52 | 1·187667 | 49 |
| 12 | 61466 | 57 | 38534 | 78451 | 57 | 21549 | 95504 | 57 | 04496 | 12619 | 57 | 87381 | 48 |
| 13 | 61749 | 61 | 38251 | 78735 | 62 | 21265 | 95789 | 62 | 04211 | 12904 | 62 | 87096 | 47 |
| 14 | 62032 | 66 | 37968 | 79019 | 66 | 20981 | 96073 | 66 | 03927 | 13190 | 67 | 86810 | 46 |
| 15 | 62314 | 71 | 37686 | 79303 | 71 | 20697 | 96358 | 71 | 03642 | 13476 | 71 | 86524 | 45 |
| 16 | 62597 | 75 | 37403 | 79586 | 76 | 20414 | 96643 | 76 | 03357 | 13762 | 76 | 86238 | 44 |
| 17 | 62879 | 80 | 37121 | 79870 | 81 | 20130 | 96928 | 81 | 03072 | 14048 | 81 | 85952 | 43 |
| 18 | 63162 | 85 | 36838 | 80154 | 85 | 19846 | 97213 | 85 | 02787 | 14333 | 86 | 85667 | 42 |
| 19 | 63444 | 90 | 36556 | 80438 | 90 | 19562 | 97498 | 90 | 02502 | 14619 | 91 | 85381 | 41 |
| 20 | 63727 | 94 | 36273 | 80721 | 95 | 19279 | 97782 | 95 | 02218 | 14905 | 95 | 85095 | 40 |
| 21 | 764010 | 99 | 1·235990 | 781005 | 100 | 1·218995 | 798067 | 100 | 1·201933 | 815191 | 100 | 1·184809 | 39 |
| 22 | 64292 | 104 | 35708 | 81289 | 104 | 18711 | 98352 | 104 | 01648 | 15477 | 105 | 84523 | 38 |
| 23 | 64575 | 109 | 35425 | 81573 | 109 | 18427 | 98637 | 109 | 01363 | 15763 | 110 | 84237 | 37 |
| 24 | 64858 | 113 | 35142 | 81857 | 114 | 18143 | 98922 | 114 | 01078 | 16049 | 115 | 83951 | 36 |
| 25 | 65141 | 118 | 34859 | 82141 | 119 | 17859 | 99207 | 119 | 00793 | 16335 | 119 | 83665 | 35 |
| 26 | 65423 | 123 | 34577 | 82425 | 123 | 17575 | 99492 | 123 | 00508 | 16620 | 124 | 83380 | 34 |
| 27 | 65706 | 127 | 34294 | 82708 | 128 | 17292 | 799777 | 128 | 1·200223 | 16906 | 129 | 83094 | 33 |
| 28 | 65989 | 132 | 34011 | 82992 | 133 | 17008 | 800062 | 133 | 1·199938 | 17192 | 134 | 82808 | 32 |
| 29 | 66272 | 137 | 33728 | 83276 | 138 | 16724 | 00347 | 138 | 99653 | 17478 | 138 | 82522 | 31 |
| 30 | 66555 | 141 | 33445 | 83560 | 142 | 16440 | 00632 | 143 | 99368 | 17764 | 143 | 82236 | 30 |
| 31 | 766837 | 146 | 1·233163 | 783844 | 147 | 1·216156 | 800917 | 147 | 1·199083 | 818050 | 148 | 1·181950 | 29 |
| 32 | 67120 | 151 | 32880 | 84128 | 152 | 15872 | 01202 | 152 | 98798 | 18336 | 153 | 81664 | 28 |
| 33 | 67403 | 156 | 32597 | 84412 | 157 | 15588 | 01487 | 157 | 98513 | 18623 | 157 | 81377 | 27 |
| 34 | 67686 | 161 | 32314 | 84696 | 161 | 15304 | 01772 | 162 | 98228 | 18909 | 162 | 81091 | 26 |
| 35 | 67969 | 165 | 32031 | 84981 | 166 | 15019 | 02057 | 166 | 97943 | 19195 | 167 | 80805 | 25 |
| 36 | 68252 | 170 | 31748 | 85265 | 171 | 14735 | 02343 | 171 | 97657 | 19481 | 172 | 80519 | 24 |
| 37 | 68535 | 175 | 31465 | 85549 | 176 | 14451 | 02628 | 176 | 97372 | 19767 | 176 | 80233 | 23 |
| 38 | 68818 | 179 | 31182 | 85833 | 180 | 14167 | 02913 | 181 | 97087 | 20053 | 181 | 79947 | 22 |
| 39 | 69101 | 184 | 30899 | 86117 | 185 | 13883 | 03198 | 185 | 96802 | 20339 | 186 | 79661 | 21 |
| 40 | 69384 | 189 | 30616 | 86401 | 190 | 13599 | 03483 | 190 | 96517 | 20625 | 191 | 79375 | 20 |
| 41 | 769667 | 194 | 1·230333 | 786685 | 195 | 1·213315 | 803769 | 195 | 1·196231 | 820912 | 195 | 1·179088 | 19 |
| 42 | 69950 | 198 | 30050 | 86970 | 199 | 13030 | 04054 | 200 | 95946 | 21198 | 200 | 78802 | 18 |
| 43 | 70233 | 203 | 29767 | 87254 | 204 | 12746 | 04339 | 205 | 95661 | 21484 | 205 | 78516 | 17 |
| 44 | 70516 | 208 | 29484 | 87538 | 209 | 12462 | 04624 | 209 | 95376 | 21770 | 210 | 78230 | 16 |
| 45 | 70800 | 213 | 29200 | 87822 | 213 | 12178 | 04910 | 214 | 95090 | 22056 | 214 | 77944 | 15 |
| 46 | 71083 | 217 | 28917 | 88107 | 218 | 11893 | 05195 | 219 | 94805 | 22343 | 219 | 77657 | 14 |
| 47 | 71366 | 222 | 28634 | 88391 | 223 | 11609 | 05480 | 224 | 94520 | 22629 | 224 | 77371 | 13 |
| 48 | 71649 | 227 | 28351 | 88675 | 228 | 11325 | 05766 | 228 | 94234 | 22915 | 229 | 77085 | 12 |
| 49 | 71932 | 232 | 28068 | 88960 | 232 | 11040 | 06051 | 233 | 93949 | 23202 | 234 | 76798 | 11 |
| 50 | 72216 | 236 | 27784 | 89244 | 237 | 10756 | 06336 | 238 | 93664 | 23488 | 238 | 76512 | 10 |
| 51 | 772499 | 241 | 1·227501 | 789528 | 242 | 1·210472 | 806622 | 243 | 1·193378 | 823774 | 243 | 1·176226 | 9 |
| 52 | 72782 | 246 | 27218 | 89813 | 247 | 10187 | 06907 | 247 | 93093 | 24060 | 248 | 75940 | 8 |
| 53 | 73065 | 250 | 26935 | 90097 | 251 | 09903 | 07193 | 252 | 92807 | 24347 | 253 | 75653 | 7 |
| 54 | 73349 | 255 | 26651 | 90381 | 256 | 09619 | 07478 | 257 | 92522 | 24633 | 257 | 75367 | 6 |
| 55 | 73632 | 260 | 26368 | 90666 | 261 | 09334 | 07763 | 262 | 92237 | 24920 | 262 | 75080 | 5 |
| 56 | 73915 | 265 | 26085 | 90950 | 266 | 09050 | 08049 | 267 | 91951 | 25206 | 267 | 74794 | 4 |
| 57 | 74199 | 269 | 25801 | 91235 | 270 | 08765 | 08334 | 271 | 91666 | 25492 | 272 | 74508 | 3 |
| 58 | 74482 | 274 | 25518 | 91519 | 275 | 08481 | 08620 | 276 | 91380 | 25779 | 276 | 74221 | 2 |
| 59 | 74765 | 279 | 25235 | 91804 | 280 | 08196 | 08905 | 281 | 91095 | 26065 | 281 | 73935 | 1 |
| 60 | 775049 | 283 | 1·224951 | 792088 | 284 | 1·207912 | 809191 | 285 | 1·190809 | 826352 | 286 | 1·173648 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | Suvers. | Parts for ″ | Versed | ′ ″ Suv. |
| | 103° | | | 102° | | | 101° | | | 100° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 80° Versed. | Parts for ″ | Suvers. | 81° Versed. | Parts for ″ | Suvers. | 82° Versed. | Parts for ″ | Suvers. | 83° Versed. | Parts for ″ | Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 826352 | 0 | 1.173648 | 843565 | 0 | 1.156435 | 860827 | 0 | 1.139173 | 878131 | 0 | 1.121869 | 60 |
| 1 | 26638 | 5 | 73362 | 43853 | 5 | 56147 | 61115 | 5 | 38885 | 78419 | 5 | 21581 | 59 |
| 2 | 26925 | 10 | 73075 | 44140 | 10 | 55860 | 61403 | 10 | 38597 | 78708 | 10 | 21292 | 58 |
| 3 | 27211 | 14 | 72789 | 44427 | 14 | 55573 | 61691 | 14 | 38309 | 78997 | 14 | 21003 | 57 |
| 4 | 27498 | 19 | 72502 | 44715 | 19 | 55285 | 61979 | 19 | 38021 | 79286 | 19 | 20714 | 56 |
| 5 | 27784 | 24 | 72216 | 45002 | 24 | 54998 | 62267 | 24 | 37733 | 79574 | 24 | 20426 | 55 |
| 6 | 28071 | 29 | 71929 | 45290 | 29 | 54710 | 62555 | 29 | 37445 | 79863 | 29 | 20137 | 54 |
| 7 | 28357 | 33 | 71643 | 45577 | 33 | 54423 | 62844 | 34 | 37156 | 80152 | 34 | 19848 | 53 |
| 8 | 28644 | 38 | 71356 | 45864 | 38 | 54136 | 63132 | 38 | 36868 | 80441 | 39 | 19559 | 52 |
| 9 | 28931 | 43 | 71069 | 46152 | 43 | 53848 | 63420 | 43 | 36580 | 80730 | 43 | 19270 | 51 |
| 10 | 29217 | 48 | 70783 | 46439 | 48 | 53561 | 63708 | 48 | 36292 | 81018 | 48 | 18982 | 50 |
| 11 | 829504 | 52 | 1.170496 | 846727 | 53 | 1.153273 | 863996 | 53 | 1.136004 | 881307 | 53 | 1.118693 | 49 |
| 12 | 29790 | 57 | 70210 | 47014 | 57 | 52986 | 64284 | 58 | 35716 | 81596 | 58 | 18404 | 48 |
| 13 | 30077 | 62 | 69923 | 47302 | 62 | 52698 | 64573 | 62 | 35427 | 81885 | 63 | 18115 | 47 |
| 14 | 30364 | 67 | 69636 | 47589 | 67 | 52411 | 64861 | 67 | 35139 | 82174 | 67 | 17826 | 46 |
| 15 | 30650 | 72 | 69350 | 47877 | 72 | 52123 | 65149 | 72 | 34851 | 82463 | 72 | 17537 | 45 |
| 16 | 30937 | 76 | 69063 | 48164 | 77 | 51836 | 65437 | 77 | 34563 | 82751 | 77 | 17249 | 44 |
| 17 | 31224 | 81 | 68776 | 48452 | 81 | 51548 | 65726 | 82 | 34274 | 83040 | 82 | 16960 | 43 |
| 18 | 31511 | 86 | 68489 | 48739 | 86 | 51261 | 66014 | 86 | 33986 | 83329 | 87 | 16671 | 42 |
| 19 | 31797 | 91 | 68203 | 49027 | 91 | 50973 | 66302 | 91 | 33698 | 83618 | 91 | 16382 | 41 |
| 20 | 32084 | 96 | 67916 | 49314 | 96 | 50686 | 66590 | 96 | 33410 | 83907 | 96 | 16093 | 40 |
| 21 | 832371 | 100 | 1.167629 | 849602 | 101 | 1.150398 | 866879 | 101 | 1.133121 | 884196 | 101 | 1.115804 | 39 |
| 22 | 32658 | 105 | 67342 | 49889 | 106 | 50111 | 67167 | 106 | 32833 | 84485 | 106 | 15515 | 38 |
| 23 | 32944 | 110 | 67056 | 50177 | 111 | 49823 | 67455 | 110 | 32545 | 84774 | 111 | 15226 | 37 |
| 24 | 33231 | 115 | 66769 | 50465 | 116 | 49535 | 67744 | 115 | 32256 | 85063 | 116 | 14937 | 36 |
| 25 | 33518 | 119 | 66482 | 50752 | 120 | 49248 | 68032 | 120 | 31968 | 85352 | 120 | 14648 | 35 |
| 26 | 33805 | 124 | 66195 | 51040 | 125 | 48960 | 68320 | 125 | 31680 | 85641 | 125 | 14359 | 34 |
| 27 | 34092 | 129 | 65908 | 51328 | 130 | 48672 | 68609 | 130 | 31391 | 85930 | 130 | 14070 | 33 |
| 28 | 34379 | 134 | 65621 | 51615 | 135 | 48385 | 68897 | 134 | 31103 | 86219 | 135 | 13781 | 32 |
| 29 | 34665 | 138 | 65335 | 51903 | 140 | 48097 | 69185 | 139 | 30815 | 86508 | 140 | 13492 | 31 |
| 30 | 34952 | 143 | 65048 | 52191 | 144 | 47809 | 69474 | 144 | 30526 | 86797 | 144 | 13203 | 30 |
| 31 | 835239 | 148 | 1.164761 | 852478 | 149 | 1.147522 | 869762 | 149 | 1.130238 | 887086 | 149 | 1.112914 | 29 |
| 32 | 35526 | 153 | 64474 | 52766 | 153 | 47234 | 70051 | 154 | 29949 | 87375 | 154 | 12625 | 28 |
| 33 | 35813 | 158 | 64187 | 53054 | 158 | 46946 | 70339 | 159 | 29661 | 87664 | 159 | 12336 | 27 |
| 34 | 36100 | 163 | 63900 | 53341 | 163 | 46659 | 70627 | 163 | 29373 | 87953 | 164 | 12047 | 26 |
| 35 | 36387 | 167 | 63613 | 53629 | 168 | 46371 | 70916 | 168 | 29084 | 88242 | 169 | 11758 | 25 |
| 36 | 36674 | 172 | 63326 | 53917 | 172 | 46083 | 71204 | 173 | 28796 | 88531 | 174 | 11469 | 24 |
| 37 | 36961 | 177 | 63039 | 54205 | 177 | 45795 | 71493 | 178 | 28507 | 88820 | 179 | 11180 | 23 |
| 38 | 37248 | 182 | 62752 | 54492 | 182 | 45508 | 71781 | 183 | 28219 | 89109 | 184 | 10891 | 22 |
| 39 | 37535 | 187 | 62465 | 54780 | 187 | 45220 | 72070 | 187 | 27930 | 89398 | 189 | 10602 | 21 |
| 40 | 37822 | 191 | 62178 | 55068 | 192 | 44932 | 72358 | 192 | 27642 | 89687 | 193 | 10313 | 20 |
| 41 | 838109 | 196 | 1.161891 | 855356 | 196 | 1.144644 | 872647 | 197 | 1.127353 | 889977 | 198 | 1.110023 | 19 |
| 42 | 38396 | 201 | 61604 | 55644 | 201 | 44356 | 72935 | 202 | 27065 | 90266 | 203 | 09734 | 18 |
| 43 | 38683 | 206 | 61317 | 55932 | 206 | 44068 | 73224 | 207 | 26776 | 90555 | 208 | 09445 | 17 |
| 44 | 38970 | 210 | 61030 | 56219 | 211 | 43781 | 73512 | 212 | 26488 | 90844 | 212 | 09156 | 16 |
| 45 | 39257 | 215 | 60743 | 56507 | 215 | 43493 | 73801 | 216 | 26199 | 91133 | 217 | 08867 | 15 |
| 46 | 39544 | 220 | 60456 | 56795 | 220 | 43205 | 74090 | 221 | 25910 | 91422 | 222 | 08578 | 14 |
| 47 | 39832 | 225 | 60168 | 57083 | 225 | 42917 | 74378 | 226 | 25622 | 91711 | 227 | 08289 | 13 |
| 48 | 40119 | 230 | 59881 | 57371 | 230 | 42629 | 74667 | 231 | 25333 | 92001 | 231 | 07999 | 12 |
| 49 | 40406 | 234 | 59594 | 57659 | 235 | 42341 | 74955 | 236 | 25045 | 92290 | 236 | 07710 | 11 |
| 50 | 40693 | 239 | 59307 | 57947 | 240 | 42053 | 75244 | 240 | 24756 | 92579 | 241 | 07421 | 10 |
| 51 | 840980 | 244 | 1.159020 | 858235 | 244 | 1.141765 | 875533 | 245 | 1.124467 | 892868 | 246 | 1.107132 | 9 |
| 52 | 41267 | 249 | 58733 | 58523 | 249 | 41477 | 75821 | 250 | 24179 | 93157 | 250 | 06843 | 8 |
| 53 | 41555 | 254 | 58445 | 58811 | 254 | 41189 | 76110 | 255 | 23890 | 93447 | 255 | 06553 | 7 |
| 54 | 41842 | 258 | 58158 | 59099 | 259 | 40901 | 76398 | 260 | 23602 | 93736 | 260 | 06264 | 6 |
| 55 | 42129 | 263 | 57871 | 59387 | 264 | 40613 | 76687 | 264 | 23313 | 94025 | 265 | 05975 | 5 |
| 56 | 42416 | 268 | 57584 | 59675 | 268 | 40325 | 76976 | 269 | 23024 | 94314 | 270 | 05686 | 4 |
| 57 | 42704 | 273 | 57296 | 59963 | 273 | 40037 | 77264 | 274 | 22736 | 94604 | 275 | 05396 | 3 |
| 58 | 42991 | 277 | 57009 | 60251 | 278 | 39749 | 77553 | 279 | 22447 | 94893 | 279 | 05107 | 2 |
| 59 | 43278 | 282 | 56722 | 60539 | 283 | 39461 | 77842 | 284 | 22158 | 95182 | 284 | 04818 | 1 |
| 60 | 843565 | 287 | 1.156435 | 860827 | 287 | 1.139173 | 878131 | 288 | 1.121869 | 895471 | 289 | 1.104529 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 99° | | | 98° | | | 97° | | | 96° | | | |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 84° Versed | Parts for ″ | 84° Suvers. | 85° Versed | Parts for ″ | 85° Suvers. | 86° Versed | Parts for ″ | 86° Suvers. | 87° Versed | Parts for ″ | 87° Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 895471 | 0 | 1.104529 | 912844 | 0 | 1.087156 | 930243 | 0 | 1.069757 | 947664 | 0 | 1.052336 | 60 |
| 1 | 95761 | 5 | 04239 | 13134 | 5 | 86866 | 30534 | 5 | 69466 | 47954 | 5 | 52046 | 59 |
| 2 | 96050 | 10 | 03950 | 13424 | 10 | 86576 | 30824 | 10 | 69176 | 48245 | 10 | 51755 | 58 |
| 3 | 96339 | 14 | 03661 | 13714 | 15 | 86286 | 31114 | 15 | 68886 | 48535 | 15 | 51465 | 57 |
| 4 | 96629 | 19 | 03371 | 14003 | 19 | 85997 | 31404 | 19 | 68596 | 48826 | 19 | 51174 | 56 |
| 5 | 96918 | 24 | 03082 | 14293 | 24 | 85707 | 31694 | 24 | 68306 | 49116 | 24 | 50884 | 55 |
| 6 | 97207 | 29 | 02793 | 14583 | 29 | 85417 | 31985 | 29 | 68015 | 49407 | 29 | 50593 | 54 |
| 7 | 97497 | 34 | 02503 | 14873 | 34 | 85127 | 32275 | 34 | 67725 | 49698 | 34 | 50302 | 53 |
| 8 | 97786 | 39 | 02214 | 15163 | 39 | 84837 | 32565 | 39 | 67435 | 49988 | 39 | 50012 | 52 |
| 9 | 98075 | 44 | 01925 | 15453 | 44 | 84547 | 32855 | 44 | 67145 | 50279 | 44 | 49721 | 51 |
| 10 | 98365 | 48 | 01635 | 15742 | 48 | 84258 | 33146 | 48 | 66854 | 50569 | 48 | 49431 | 50 |
| 11 | 898654 | 53 | 1.101346 | 916032 | 53 | 1.083968 | 933436 | 53 | 1.066561 | 950860 | 53 | 1.049140 | 49 |
| 12 | 98944 | 58 | 01056 | 16322 | 58 | 83678 | 33726 | 58 | 66274 | 51150 | 58 | 48850 | 48 |
| 13 | 99233 | 63 | 00767 | 16612 | 63 | 83388 | 34016 | 63 | 65984 | 51441 | 63 | 48559 | 47 |
| 14 | 99522 | 68 | 00478 | 16902 | 68 | 83098 | 34307 | 68 | 65693 | 51731 | 68 | 48269 | 46 |
| 15 | 899812 | 72 | 1.100188 | 17192 | 73 | 82808 | 34597 | 73 | 65403 | 52022 | 73 | 47978 | 45 |
| 16 | 900101 | 77 | 1.099899 | 17482 | 77 | 82518 | 34887 | 77 | 65113 | 52312 | 77 | 47688 | 44 |
| 17 | 00391 | 82 | 99609 | 17772 | 82 | 82228 | 35177 | 82 | 64823 | 52603 | 82 | 47397 | 43 |
| 18 | 00680 | 87 | 99320 | 18061 | 87 | 81939 | 35468 | 87 | 64532 | 52893 | 87 | 47107 | 42 |
| 19 | 00970 | 92 | 99030 | 18351 | 92 | 81649 | 35758 | 92 | 64242 | 53184 | 92 | 46816 | 41 |
| 20 | 01259 | 97 | 98741 | 18641 | 97 | 81359 | 36048 | 97 | 63952 | 53475 | 97 | 46525 | 40 |
| 21 | 901549 | 102 | 1.098451 | 918931 | 102 | 1.081069 | 936339 | 102 | 1.063661 | 953765 | 102 | 1.046235 | 39 |
| 22 | 01838 | 107 | 98162 | 19221 | 107 | 80779 | 36629 | 106 | 63371 | 54056 | 106 | 45944 | 38 |
| 23 | 02128 | 112 | 97872 | 19511 | 112 | 80489 | 36919 | 111 | 63081 | 54346 | 111 | 45654 | 37 |
| 24 | 02417 | 116 | 97583 | 19801 | 116 | 80199 | 37209 | 116 | 62791 | 54637 | 116 | 45363 | 36 |
| 25 | 02707 | 121 | 97293 | 20091 | 121 | 79909 | 37500 | 121 | 62500 | 54928 | 121 | 45072 | 35 |
| 26 | 02996 | 126 | 97004 | 20381 | 126 | 79619 | 37790 | 126 | 62210 | 55218 | 126 | 44782 | 34 |
| 27 | 03286 | 131 | 96714 | 20671 | 131 | 79329 | 38080 | 131 | 61920 | 55509 | 131 | 44491 | 33 |
| 28 | 03575 | 136 | 96425 | 20961 | 136 | 79039 | 38371 | 136 | 61629 | 55799 | 136 | 44201 | 32 |
| 29 | 03865 | 141 | 96135 | 21251 | 141 | 78749 | 38661 | 140 | 61339 | 56090 | 140 | 43910 | 31 |
| 30 | 04154 | 145 | 95846 | 21541 | 145 | 78459 | 38951 | 145 | 61049 | 56381 | 145 | 43619 | 30 |
| 31 | 904444 | 150 | 1.095556 | 921831 | 150 | 1.078169 | 939242 | 150 | 1.060758 | 956671 | 150 | 1.043329 | 29 |
| 32 | 04733 | 155 | 95267 | 22121 | 155 | 77879 | 39532 | 155 | 60468 | 56962 | 155 | 43038 | 28 |
| 33 | 05023 | 160 | 94977 | 22411 | 160 | 77589 | 39822 | 160 | 60178 | 57252 | 160 | 42748 | 27 |
| 34 | 05312 | 164 | 94688 | 22701 | 164 | 77299 | 40113 | 165 | 59887 | 57543 | 165 | 42457 | 26 |
| 35 | 05602 | 169 | 94398 | 22991 | 169 | 77009 | 40403 | 169 | 59597 | 57834 | 169 | 42166 | 25 |
| 36 | 05892 | 174 | 94108 | 23281 | 174 | 76719 | 40694 | 174 | 59306 | 58124 | 174 | 41876 | 24 |
| 37 | 06181 | 179 | 93819 | 23571 | 179 | 76429 | 40984 | 179 | 59016 | 58415 | 179 | 41585 | 23 |
| 38 | 06471 | 184 | 93529 | 23861 | 184 | 76139 | 41274 | 184 | 58726 | 58706 | 184 | 41294 | 22 |
| 39 | 06760 | 189 | 93240 | 24151 | 189 | 75849 | 41565 | 189 | 58435 | 58996 | 189 | 41004 | 21 |
| 40 | 07050 | 193 | 92950 | 24441 | 193 | 75559 | 41855 | 194 | 58145 | 59287 | 194 | 40713 | 20 |
| 41 | 907340 | 198 | 1.092660 | 924731 | 198 | 1.075269 | 942146 | 198 | 1.057854 | 959578 | 198 | 1.040422 | 19 |
| 42 | 07629 | 203 | 92371 | 25021 | 203 | 74979 | 42436 | 203 | 57564 | 59868 | 203 | 40132 | 18 |
| 43 | 07919 | 208 | 92081 | 25311 | 208 | 74689 | 42726 | 208 | 57274 | 60159 | 208 | 39841 | 17 |
| 44 | 08209 | 213 | 91791 | 25601 | 213 | 74399 | 43017 | 213 | 56983 | 60449 | 213 | 39551 | 16 |
| 45 | 08498 | 218 | 91502 | 25891 | 218 | 74109 | 43307 | 218 | 56693 | 60740 | 218 | 39260 | 15 |
| 46 | 08788 | 222 | 91212 | 26182 | 222 | 73818 | 43598 | 223 | 56402 | 61031 | 223 | 38969 | 14 |
| 47 | 09078 | 227 | 90922 | 26472 | 227 | 73528 | 43888 | 227 | 56112 | 61321 | 227 | 38679 | 13 |
| 48 | 09367 | 232 | 90633 | 26762 | 232 | 73238 | 44178 | 232 | 55822 | 61612 | 232 | 38388 | 12 |
| 49 | 09657 | 237 | 90343 | 27052 | 237 | 72948 | 44469 | 237 | 55531 | 61903 | 237 | 38097 | 11 |
| 50 | 09947 | 242 | 90053 | 27342 | 242 | 72658 | 44759 | 242 | 55241 | 62193 | 242 | 37807 | 10 |
| 51 | 910236 | 247 | 1.089764 | 927632 | 247 | 1.072368 | 945050 | 247 | 1.054950 | 962484 | 247 | 1.037516 | 9 |
| 52 | 10526 | 252 | 89474 | 27922 | 252 | 72078 | 45340 | 252 | 54660 | 62775 | 252 | 37225 | 8 |
| 53 | 10816 | 257 | 89184 | 28212 | 257 | 71788 | 45631 | 257 | 54369 | 63066 | 257 | 36934 | 7 |
| 54 | 11106 | 261 | 88894 | 28503 | 261 | 71497 | 45921 | 261 | 54079 | 63356 | 261 | 36644 | 6 |
| 55 | 11395 | 266 | 88605 | 28793 | 266 | 71207 | 46212 | 266 | 53788 | 63647 | 266 | 36353 | 5 |
| 56 | 11685 | 271 | 88315 | 29083 | 271 | 70917 | 46502 | 271 | 53498 | 63938 | 271 | 36062 | 4 |
| 57 | 11975 | 276 | 88025 | 29373 | 276 | 70627 | 46793 | 276 | 53207 | 64228 | 276 | 35772 | 3 |
| 58 | 12265 | 281 | 87735 | 29663 | 281 | 70337 | 47083 | 281 | 52917 | 64519 | 281 | 35481 | 2 |
| 59 | 12554 | 285 | 87446 | 29953 | 285 | 70047 | 47374 | 286 | 52626 | 64810 | 286 | 35190 | 1 |
| 60 | 912844 | 290 | 1.087156 | 930243 | 290 | 1.069757 | 947664 | 290 | 1.052336 | 965101 | 290 | 1.034899 | 0 |
| ″ Vers. | 95° Suvers. | Parts for ″ | 95° Versed. | 94° Suvers. | Parts for ″ | 94° Versed. | 93° Suvers. | Parts for ″ | 93° Versed. | 92° Suvers. | Parts for ″ | 92° Versed. | ′ ″ Suv. |

# TABLE XXXVI.

## Natural Versed and Suversed Sines.

| ′ ″ Vers. | 88° Versed | Parts for ″ | 88° Suvers. | 89° Versed | Parts for ″ | 89° Suvers. | ″ Suv. |
|---|---|---|---|---|---|---|---|
| 0 | 965101 | 0 | 1.034809 | 0.982548 | 0 | 1.017452 | 60 |
| 1 | 65391 | 5 | 34609 | 82838 | 5 | 17162 | 59 |
| 2 | 65682 | 10 | 34318 | 83129 | 10 | 16871 | 58 |
| 3 | 65973 | 15 | 34027 | 83420 | 15 | 16580 | 57 |
| 4 | 66263 | 19 | 33737 | 83711 | 19 | 16289 | 56 |
| 5 | 66554 | 24 | 33446 | 84002 | 24 | 15998 | 55 |
| 6 | 66845 | 29 | 33155 | 84293 | 29 | 15707 | 54 |
| 7 | 67136 | 34 | 32864 | 84583 | 34 | 15417 | 53 |
| 8 | 67426 | 39 | 32574 | 84874 | 39 | 15126 | 52 |
| 9 | 67717 | 44 | 32283 | 85165 | 44 | 14835 | 51 |
| 10 | 68008 | 48 | 31992 | 85456 | 49 | 14544 | 50 |
| 11 | 968298 | 53 | 1.031702 | 0.985747 | 53 | 1.014253 | 49 |
| 12 | 68589 | 58 | 31411 | 86038 | 58 | 13962 | 48 |
| 13 | 68880 | 63 | 31120 | 86329 | 63 | 13671 | 47 |
| 14 | 69171 | 68 | 30829 | 86619 | 68 | 13381 | 46 |
| 15 | 69461 | 73 | 30539 | 86910 | 73 | 13090 | 45 |
| 16 | 69752 | 78 | 30248 | 87201 | 78 | 12799 | 44 |
| 17 | 70043 | 82 | 29957 | 87492 | 83 | 12508 | 43 |
| 18 | 70334 | 87 | 29666 | 87783 | 87 | 12217 | 42 |
| 19 | 70624 | 92 | 29376 | 88074 | 92 | 11926 | 41 |
| 20 | 70915 | 97 | 29085 | 88365 | 97 | 11635 | 40 |
| 21 | 971206 | 102 | 1.028794 | 0.988656 | 102 | 1.011344 | 39 |
| 22 | 71497 | 107 | 28503 | 88946 | 107 | 11054 | 38 |
| 23 | 71788 | 111 | 28212 | 89237 | 112 | 10763 | 37 |
| 24 | 72078 | 116 | 27922 | 89528 | 116 | 10472 | 36 |
| 25 | 72369 | 121 | 27631 | 89819 | 121 | 10181 | 35 |
| 26 | 72660 | 126 | 27340 | 90110 | 126 | 09890 | 34 |
| 27 | 72951 | 131 | 27049 | 90401 | 131 | 09599 | 33 |
| 28 | 73241 | 136 | 26759 | 90692 | 136 | 09308 | 32 |
| 29 | 73532 | 141 | 26468 | 90983 | 141 | 09017 | 31 |
| 30 | 73823 | 145 | 26177 | 91273 | 145 | 08727 | 30 |
| 31 | 974114 | 150 | 1.025886 | 0.991564 | 150 | 1.008436 | 29 |
| 32 | 74405 | 155 | 25595 | 91855 | 155 | 08145 | 28 |
| 33 | 74695 | 160 | 25305 | 92146 | 160 | 07854 | 27 |
| 34 | 74986 | 165 | 25014 | 92437 | 165 | 07563 | 26 |
| 35 | 75277 | 170 | 24723 | 92728 | 170 | 07272 | 25 |
| 36 | 75568 | 175 | 24432 | 93019 | 175 | 06981 | 24 |
| 37 | 75859 | 179 | 24141 | 93310 | 179 | 06690 | 23 |
| 38 | 76149 | 184 | 23851 | 93600 | 184 | 06400 | 22 |
| 39 | 76440 | 189 | 23560 | 93891 | 189 | 06109 | 21 |
| 40 | 76731 | 194 | 23269 | 94182 | 194 | 05818 | 20 |
| 41 | 977022 | 199 | 1.022978 | 0.994473 | 199 | 1.005527 | 19 |
| 42 | 77313 | 204 | 22687 | 94764 | 204 | 05236 | 18 |
| 43 | 77603 | 208 | 22397 | 95055 | 209 | 04945 | 17 |
| 44 | 77894 | 213 | 22106 | 95346 | 213 | 04654 | 16 |
| 45 | 78185 | 218 | 21815 | 95637 | 218 | 04363 | 15 |
| 46 | 78476 | 223 | 21524 | 95928 | 223 | 04072 | 14 |
| 47 | 78767 | 228 | 21233 | 96218 | 228 | 03782 | 13 |
| 48 | 79058 | 233 | 20942 | 96509 | 233 | 03491 | 12 |
| 49 | 79348 | 238 | 20652 | 96800 | 238 | 03200 | 11 |
| 50 | 79639 | 242 | 20361 | 97091 | 243 | 02909 | 10 |
| 51 | 979930 | 247 | 1.020070 | 0.997382 | 247 | 1.002618 | 9 |
| 52 | 80221 | 252 | 19779 | 97673 | 252 | 02327 | 8 |
| 53 | 80512 | 257 | 19488 | 97964 | 257 | 02036 | 7 |
| 54 | 80803 | 262 | 19197 | 98255 | 262 | 01745 | 6 |
| 55 | 81093 | 267 | 18907 | 98546 | 267 | 01454 | 5 |
| 56 | 81384 | 271 | 18616 | 98836 | 272 | 01164 | 4 |
| 57 | 81675 | 276 | 18325 | 99127 | 276 | 00873 | 3 |
| 58 | 81966 | 281 | 18034 | 99418 | 281 | 00582 | 2 |
| 59 | 82257 | 286 | 17743 | 0.999709 | 286 | 00291 | 1 |
| 60 | 982548 | 291 | 1.017452 | 1.000000 | 291 | 1.000000 | 0 |
| ″ Vers. | Suvers. | Parts for ″ | Versed. | Suvers. | Parts for ″ | Versed. | ′ ″ Suv. |
| | 91° | | | 90° | | | |

# TABLE XXXVII.

## For reducing Sidereal to Mean Solar Time.

| Hrs. | Min. | Sec. | Min. | Sec. | Sec. | Sec. |
|---|---|---|---|---|---|---|
| 1 | 0 | 9.83 | 1 | 0.16 | 1 | 0.00 |
| 2 | 0 | 19.66 | 2 | 0.33 | 2 | 0.01 |
| 3 | 0 | 29.49 | 3 | 0.49 | 3 | 0.01 |
| 4 | 0 | 39.32 | 4 | 0.66 | 4 | 0.01 |
| 5 | 0 | 49.15 | 5 | 0.82 | 5 | 0.01 |
| 6 | 0 | 58.98 | 6 | 0.98 | 6 | 0.02 |
| 7 | 1 | 8.81 | 7 | 1.15 | 7 | 0.02 |
| 8 | 1 | 18.64 | 8 | 1.31 | 8 | 0.02 |
| 9 | 1 | 28.47 | 9 | 1.47 | 9 | 0.02 |
| 10 | 1 | 38.30 | 10 | 1.64 | 10 | 0.03 |
| 11 | 1 | 48.13 | 11 | 1.80 | 11 | 0.03 |
| 12 | 1 | 57.96 | 12 | 1.97 | 12 | 0.03 |
| 13 | 2 | 7.78 | 13 | 2.13 | 13 | 0.04 |
| 14 | 2 | 17.61 | 14 | 2.29 | 14 | 0.04 |
| 15 | 2 | 27.44 | 15 | 2.46 | 15 | 0.04 |
| 16 | 2 | 37.27 | 16 | 2.62 | 16 | 0.04 |
| 17 | 2 | 47.10 | 17 | 2.78 | 17 | 0.05 |
| 18 | 2 | 56.93 | 18 | 2.95 | 18 | 0.05 |
| 19 | 3 | 6.76 | 19 | 3.11 | 19 | 0.05 |
| 20 | 3 | 16.59 | 20 | 3.28 | 20 | 0.05 |
| 21 | 3 | 26.42 | 30 | 4.91 | 30 | 0.08 |
| 22 | 3 | 36.25 | 40 | 6.55 | 40 | 0.11 |
| 23 | 3 | 46.08 | 50 | 8.19 | 50 | 0.14 |
| 24 | 3 | 55.91 | 60 | 9.83 | 60 | 0.16 |

# TABLE XXXVIII.

## For reducing Mean Solar to Sidereal Time.

| Hrs. | Min. | Sec. | Min. | Sec. | Sec. | Sec. |
|---|---|---|---|---|---|---|
| 1 | 0 | 9.86 | 1 | 0.16 | 1 | 0.00 |
| 2 | 0 | 19.71 | 2 | 0.33 | 2 | 0.01 |
| 3 | 0 | 29.57 | 3 | 0.49 | 3 | 0.01 |
| 4 | 0 | 39.43 | 4 | 0.66 | 4 | 0.01 |
| 5 | 0 | 49.28 | 5 | 0.82 | 5 | 0.01 |
| 6 | 0 | 59.14 | 6 | 0.99 | 6 | 0.02 |
| 7 | 1 | 8.99 | 7 | 1.15 | 7 | 0.02 |
| 8 | 1 | 18.85 | 8 | 1.31 | 8 | 0.02 |
| 9 | 1 | 28.71 | 9 | 1.48 | 9 | 0.02 |
| 10 | 1 | 38.56 | 10 | 1.64 | 10 | 0.03 |
| 11 | 1 | 48.42 | 11 | 1.81 | 11 | 0.03 |
| 12 | 1 | 58.28 | 12 | 1.97 | 12 | 0.03 |
| 13 | 2 | 8.13 | 13 | 2.14 | 13 | 0.04 |
| 14 | 2 | 17.99 | 14 | 2.30 | 14 | 0.04 |
| 15 | 2 | 27.85 | 15 | 2.46 | 15 | 0.04 |
| 16 | 2 | 37.70 | 16 | 2.63 | 16 | 0.04 |
| 17 | 2 | 47.56 | 17 | 2.79 | 17 | 0.05 |
| 18 | 2 | 57.42 | 18 | 2.96 | 18 | 0.05 |
| 19 | 3 | 7.27 | 19 | 3.12 | 19 | 0.05 |
| 20 | 3 | 17.13 | 20 | 3.28 | 20 | 0.05 |
| 21 | 3 | 26.99 | 30 | 4.93 | 30 | 0.08 |
| 22 | 3 | 36.84 | 40 | 6.57 | 40 | 0.11 |
| 23 | 3 | 46.70 | 50 | 8.21 | 50 | 0.14 |
| 24 | 3 | 56.55 | 60 | 9.86 | 60 | 0.16 |

# TABLE XXXIX.

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 3° | 4° | 5° | 6° | 7° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.999839 | 9727 | 9612 | 9496 | 9380 | 193 |
| 10 | 9838 | 9725 | 9610 | 9494 | 9377 | 193 |
| 20 | 9836 | 9723 | 9608 | 9491 | 9374 | 194 |
| 30 | 9835 | 9721 | 9606 | 9489 | 9371 | 194 |
| 40 | 9833 | 9720 | 9604 | 9486 | 9369 | 195 |
| 50 | 9832 | 9718 | 9602 | 9484 | 9366 | 195 |
| 54 0 | 9.999831 | 9716 | 9599 | 9481 | 9363 | 196 |
| 10 | 9829 | 9714 | 9597 | 9479 | 9360 | 196 |
| 20 | 9828 | 9713 | 9595 | 9476 | 9357 | 197 |
| 30 | 9827 | 9711 | 9593 | 9474 | 9354 | 197 |
| 40 | 9826 | 9709 | 9591 | 9471 | 9351 | 198 |
| 50 | 9824 | 9707 | 9589 | 9469 | 9348 | 199 |
| 55 0 | 9.999823 | 9706 | 9587 | 9466 | 9345 | 200 |
| 10 | 9821 | 9704 | 9584 | 9464 | 9342 | 200 |
| 20 | 9820 | 9702 | 9582 | 9461 | 9339 | 201 |
| 30 | 9819 | 9700 | 9580 | 9459 | 9337 | 201 |
| 40 | 9817 | 9699 | 9578 | 9456 | 9334 | 202 |
| 50 | 9816 | 9697 | 9576 | 9454 | 9331 | 202 |
| 56 0 | 9.999815 | 9695 | 9574 | 9451 | 9328 | 203 |
| 10 | 9813 | 9693 | 9571 | 9449 | 9325 | 203 |
| 20 | 9812 | 9692 | 9569 | 9447 | 9322 | 204 |
| 30 | 9811 | 9690 | 9567 | 9444 | 9320 | 205 |
| 40 | 9809 | 9688 | 9565 | 9442 | 9317 | 205 |
| 50 | 9808 | 9686 | 9563 | 9439 | 9314 | 206 |
| 57 0 | 9.999807 | 9685 | 9561 | 9437 | 9311 | 207 |
| 10 | 9805 | 9683 | 9559 | 9434 | 9308 | 207 |
| 20 | 9804 | 9681 | 9557 | 9432 | 9305 | 208 |
| 30 | 9803 | 9680 | 9555 | 9429 | 9303 | 209 |
| 40 | 9801 | 9678 | 9553 | 9427 | 9300 | 209 |
| 50 | 9800 | 9676 | 9551 | 9424 | 9297 | 210 |
| 58 0 | 9.999799 | 9675 | 9549 | 9422 | 9294 | 211 |
| 10 | 9797 | 9673 | 9546 | 9419 | 9291 | 211 |
| 20 | 9796 | 9671 | 9544 | 9417 | 9288 | 212 |
| 30 | 9794 | 9669 | 9542 | 9414 | 9286 | 212 |
| 40 | 9793 | 9668 | 9540 | 9412 | 9283 | 213 |
| 50 | 9791 | 9666 | 9538 | 9409 | 9280 | 214 |
| 59 0 | 9.999790 | 9664 | 9536 | 9407 | 9277 | 214 |
| 10 | 9789 | 9662 | 9533 | 9404 | 9274 | 215 |
| 20 | 9787 | 9661 | 9531 | 9402 | 9271 | 216 |
| 30 | 9786 | 9659 | 9529 | 9399 | 9268 | 217 |
| 40 | 9785 | 9657 | 9527 | 9397 | 9265 | 217 |
| 50 | 9783 | 9655 | 9525 | 9394 | 9262 | 218 |
| 60 0 | 9.999782 | 9653 | 9523 | 9392 | 9259 | 218 |
| 10 | 9781 | 9652 | 9520 | 9389 | 9257 | 219 |
| 20 | 9779 | 9650 | 9518 | 9387 | 9254 | 219 |
| 30 | 9778 | 9648 | 9516 | 9384 | 9251 | 220 |
| 40 | 9777 | 9646 | 9514 | 9382 | 9248 | 220 |
| 50 | 9775 | 9645 | 9512 | 9379 | 9245 | 221 |
| 61 0 | 9.999774 | 9643 | 9510 | 9376 | 9242 | 222 |
| 10 | 9772 | 9641 | 9507 | 9374 | 9239 | 223 |
| 20 | 9771 | 9639 | 9505 | 9371 | 9236 | 223 |
| 30 | 9769 | 9638 | 9503 | 9369 | 9233 | 224 |
| 40 | 9768 | 9636 | 9501 | 9366 | 9230 | 225 |
| 50 | 9766 | 9634 | 9499 | 9364 | 9227 | 225 |
| 62 0 | 9.999765 | 9632 | 9497 | 9361 | 9224 | 226 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | |

| Moon's Hor. Par. | App. Alt. Moon's Center. 8° | 9° | 10° | 11° | 12° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.999264 | 9148 | 9032 | 8917 | 8803 | 192 |
| 10 | 9261 | 9144 | 9028 | 8913 | 8798 | 192 |
| 20 | 9257 | 9140 | 9024 | 8908 | 8794 | 193 |
| 30 | 9254 | 9137 | 9021 | 8904 | 8789 | 194 |
| 40 | 9251 | 9133 | 9017 | 8900 | 8784 | 194 |
| 50 | 9247 | 9129 | 9013 | 8895 | 8779 | 195 |
| 54 0 | 9.999244 | 9126 | 9009 | 8891 | 8774 | 196 |
| 10 | 9241 | 9122 | 9005 | 8887 | 8770 | 197 |
| 20 | 9238 | 9119 | 9001 | 8882 | 8765 | 197 |
| 30 | 9234 | 9115 | 8997 | 8878 | 8760 | 198 |
| 40 | 9231 | 9112 | 8993 | 8874 | 8756 | 199 |
| 50 | 9228 | 9108 | 8989 | 8869 | 8751 | 199 |
| 55 0 | 9.999225 | 9105 | 8985 | 8865 | 8746 | 200 |
| 10 | 9222 | 9101 | 8981 | 8860 | 8742 | 201 |
| 20 | 9219 | 9098 | 8977 | 8856 | 8737 | 201 |
| 30 | 9216 | 9094 | 8973 | 8852 | 8732 | 202 |
| 40 | 9212 | 9091 | 8969 | 8847 | 8727 | 202 |
| 50 | 9209 | 9087 | 8965 | 8843 | 8722 | 203 |
| 56 0 | 9.999206 | 9083 | 8961 | 8839 | 8718 | 203 |
| 10 | 9203 | 9079 | 8957 | 8834 | 8713 | 204 |
| 20 | 9199 | 9076 | 8953 | 8830 | 8708 | 205 |
| 30 | 9196 | 9072 | 8949 | 8826 | 8704 | 205 |
| 40 | 9193 | 9069 | 8945 | 8821 | 8699 | 206 |
| 50 | 9190 | 9065 | 8941 | 8817 | 8694 | 206 |
| 57 0 | 9.999186 | 9062 | 8937 | 8813 | 8690 | 207 |
| 10 | 9183 | 9058 | 8934 | 8808 | 8685 | 208 |
| 20 | 9180 | 9055 | 8930 | 8804 | 8680 | 209 |
| 30 | 9176 | 9051 | 8926 | 8800 | 8676 | 210 |
| 40 | 9173 | 9048 | 8922 | 8795 | 8671 | 211 |
| 50 | 9170 | 9044 | 8918 | 8791 | 8666 | 212 |
| 58 0 | 9.999167 | 9040 | 8914 | 8787 | 8662 | 212 |
| 10 | 9163 | 9037 | 8910 | 8782 | 8657 | 213 |
| 20 | 9160 | 9033 | 8906 | 8778 | 8652 | 213 |
| 30 | 9157 | 9029 | 8902 | 8774 | 8648 | 214 |
| 40 | 9154 | 9026 | 8898 | 8769 | 8643 | 214 |
| 50 | 9151 | 9022 | 8894 | 8765 | 8638 | 215 |
| 59 0 | 9.999147 | 9018 | 8890 | 8761 | 8634 | 215 |
| 10 | 9144 | 9014 | 8886 | 8756 | 8629 | 216 |
| 20 | 9141 | 9011 | 8882 | 8752 | 8624 | 216 |
| 30 | 9137 | 9007 | 8878 | 8748 | 8619 | 217 |
| 40 | 9134 | 9004 | 8874 | 8743 | 8615 | 217 |
| 50 | 9131 | 9000 | 8870 | 8739 | 8610 | 218 |
| 60 0 | 9.999128 | 8997 | 8866 | 8735 | 8605 | 218 |
| 10 | 9124 | 8993 | 8862 | 8730 | 8600 | 219 |
| 20 | 9121 | 8990 | 8858 | 8726 | 8596 | 220 |
| 30 | 9118 | 8986 | 8854 | 8722 | 8591 | 220 |
| 40 | 9115 | 8982 | 8850 | 8717 | 8586 | 221 |
| 50 | 9112 | 8979 | 8846 | 8713 | 8581 | 222 |
| 61 0 | 9.999108 | 8975 | 8842 | 8709 | 8577 | 222 |
| 10 | 9105 | 8971 | 8838 | 8704 | 8572 | 223 |
| 20 | 9102 | 8968 | 8834 | 8700 | 8567 | 223 |
| 30 | 9098 | 8964 | 8830 | 8695 | 8562 | 224 |
| 40 | 9095 | 8960 | 8826 | 8691 | 8558 | 224 |
| 50 | 9092 | 8957 | 8822 | 8687 | 8553 | 225 |
| 62 0 | 9.999089 | 8953 | 8818 | 8683 | 8548 | 225 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | |

# TABLE XXXIX.

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 13° | 14° | 15° | 16° | 17° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.998688 | 8574 | 8461 | 8348 | 8236 | 188 |
| 10 | 8683 | 8569 | 8455 | 8342 | 8230 | 189 |
| 20 | 8678 | 8563 | 8449 | 8336 | 8223 | 190 |
| 30 | 8673 | 8558 | 8443 | 8329 | 8217 | 191 |
| 40 | 8668 | 8553 | 8437 | 8323 | 8210 | 191 |
| 50 | 8663 | 8547 | 8432 | 8317 | 8203 | 192 |
| 54 0 | 9.998658 | 8542 | 8426 | 8311 | 8197 | 192 |
| 10 | 8653 | 8537 | 8420 | 8305 | 8190 | 193 |
| 20 | 8648 | 8531 | 8414 | 8299 | 8184 | 193 |
| 30 | 8643 | 8526 | 8409 | 8293 | 8177 | 194 |
| 40 | 8638 | 8521 | 8403 | 8287 | 8171 | 195 |
| 50 | 8633 | 8515 | 8397 | 8281 | 8164 | 195 |
| 55 0 | 9.998628 | 8510 | 8391 | 8275 | 8158 | 196 |
| 10 | 8623 | 8504 | 8386 | 8269 | 8151 | 196 |
| 20 | 8618 | 8498 | 8380 | 8262 | 8145 | 197 |
| 30 | 8613 | 8493 | 8374 | 8256 | 8138 | 197 |
| 40 | 8607 | 8488 | 8368 | 8250 | 8132 | 198 |
| 50 | 8602 | 8482 | 8363 | 8244 | 8125 | 198 |
| 56 0 | 9.998597 | 8477 | 8357 | 8238 | 8119 | 199 |
| 10 | 8592 | 8471 | 8351 | 8232 | 8112 | 199 |
| 20 | 8587 | 8466 | 8345 | 8225 | 8106 | 200 |
| 30 | 8582 | 8460 | 8339 | 8219 | 8099 | 201 |
| 40 | 8577 | 8455 | 8334 | 8213 | 8093 | 201 |
| 50 | 8572 | 8449 | 8328 | 8207 | 8086 | 202 |
| 57 0 | 9.998567 | 8444 | 8322 | 8201 | 8080 | 202 |
| 10 | 8562 | 8439 | 8316 | 8195 | 8073 | 203 |
| 20 | 8557 | 8433 | 8311 | 8189 | 8067 | 203 |
| 30 | 8552 | 8428 | 8305 | 8183 | 8060 | 204 |
| 40 | 8546 | 8423 | 8299 | 8177 | 8054 | 205 |
| 50 | 8541 | 8418 | 8294 | 8171 | 8047 | 206 |
| 58 0 | 9.998536 | 8412 | 8288 | 8165 | 8041 | 206 |
| 10 | 8531 | 8407 | 8282 | 8159 | 8034 | 207 |
| 20 | 8526 | 8401 | 8276 | 8152 | 8028 | 207 |
| 30 | 8521 | 8396 | 8271 | 8146 | 8021 | 208 |
| 40 | 8516 | 8391 | 8265 | 8140 | 8015 | 209 |
| 50 | 8511 | 8385 | 8259 | 8134 | 8008 | 209 |
| 59 0 | 9.998506 | 8380 | 8253 | 8128 | 8002 | 210 |
| 10 | 8501 | 8374 | 8247 | 8122 | 7995 | 211 |
| 20 | 8496 | 8369 | 8241 | 8115 | 7989 | 211 |
| 30 | 8491 | 8363 | 8236 | 8109 | 7982 | 212 |
| 40 | 8486 | 8358 | 8230 | 8103 | 7976 | 212 |
| 50 | 8481 | 8352 | 8224 | 8097 | 7969 | 213 |
| 60 0 | 9.998476 | 8347 | 8218 | 8091 | 7963 | 213 |
| 10 | 8471 | 8341 | 8212 | 8085 | 7956 | 214 |
| 20 | 8466 | 8336 | 8206 | 8078 | 7950 | 215 |
| 30 | 8461 | 8330 | 8201 | 8072 | 7943 | 215 |
| 40 | 8455 | 8325 | 8195 | 8066 | 7937 | 216 |
| 50 | 8450 | 8319 | 8189 | 8060 | 7930 | 216 |
| 61 0 | 9.998445 | 8314 | 8183 | 8054 | 7924 | 217 |
| 10 | 8440 | 8308 | 8177 | 8047 | 7917 | 217 |
| 20 | 8435 | 8303 | 8171 | 8041 | 7911 | 218 |
| 30 | 8430 | 8297 | 8165 | 8035 | 7904 | 218 |
| 40 | 8425 | 8292 | 8160 | 8029 | 7898 | 219 |
| 50 | 8420 | 8286 | 8154 | 8023 | 7891 | 219 |
| 62 0 | 9.998415 | 8281 | 8149 | 8017 | 7885 | 220 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 5 | |

| Moon's Hor. Par. | App. Alt. Moon's Center. 18° | 19° | 20° | 21° | 22° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.998121 | 8013 | 7902 | 7792 | 7684 | 184 |
| 10 | 8117 | 8006 | 7895 | 7784 | 7675 | 185 |
| 20 | 8110 | 7998 | 7887 | 7776 | 7667 | 185 |
| 30 | 8104 | 7991 | 7880 | 7769 | 7659 | 186 |
| 40 | 8097 | 7984 | 7872 | 7761 | 7651 | 186 |
| 50 | 8090 | 7977 | 7865 | 7753 | 7643 | 187 |
| 54 0 | 9.998083 | 7970 | 7857 | 7745 | 7635 | 187 |
| 10 | 8076 | 7963 | 7850 | 7737 | 7626 | 188 |
| 20 | 8069 | 7955 | 7842 | 7730 | 7618 | 188 |
| 30 | 8063 | 7948 | 7835 | 7722 | 7610 | 189 |
| 40 | 8056 | 7941 | 7827 | 7714 | 7602 | 189 |
| 50 | 8049 | 7934 | 7820 | 7706 | 7594 | 190 |
| 55 0 | 9.998042 | 7927 | 7812 | 7698 | 7586 | 190 |
| 10 | 8035 | 7920 | 7805 | 7690 | 7577 | 191 |
| 20 | 8028 | 7913 | 7798 | 7683 | 7569 | 191 |
| 30 | 8022 | 7905 | 7790 | 7675 | 7561 | 192 |
| 40 | 8015 | 7898 | 7782 | 7667 | 7553 | 192 |
| 50 | 8008 | 7891 | 7775 | 7659 | 7545 | 193 |
| 56 0 | 9.998001 | 7884 | 7767 | 7651 | 7537 | 193 |
| 10 | 7994 | 7877 | 7760 | 7644 | 7528 | 194 |
| 20 | 7987 | 7869 | 7752 | 7636 | 7520 | 194 |
| 30 | 7981 | 7862 | 7745 | 7628 | 7512 | 195 |
| 40 | 7974 | 7855 | 7737 | 7620 | 7504 | 196 |
| 50 | 7967 | 7848 | 7730 | 7612 | 7495 | 196 |
| 57 0 | 9.997960 | 7841 | 7722 | 7604 | 7487 | 197 |
| 10 | 7953 | 7834 | 7715 | 7596 | 7479 | 198 |
| 20 | 7946 | 7826 | 7707 | 7588 | 7470 | 198 |
| 30 | 7940 | 7819 | 7700 | 7580 | 7462 | 199 |
| 40 | 7933 | 7812 | 7692 | 7572 | 7454 | 200 |
| 50 | 7926 | 7805 | 7685 | 7564 | 7446 | 200 |
| 58 0 | 9.997919 | 7798 | 7677 | 7556 | 7438 | 201 |
| 10 | 7912 | 7790 | 7670 | 7549 | 7429 | 201 |
| 20 | 7905 | 7783 | 7662 | 7541 | 7421 | 202 |
| 30 | 7899 | 7776 | 7655 | 7533 | 7413 | 203 |
| 40 | 7892 | 7769 | 7647 | 7525 | 7405 | 203 |
| 50 | 7885 | 7762 | 7640 | 7517 | 7396 | 204 |
| 59 0 | 9.997878 | 7754 | 7632 | 7509 | 7388 | 204 |
| 10 | 7871 | 7747 | 7625 | 7501 | 7380 | 205 |
| 20 | 7864 | 7740 | 7617 | 7493 | 7371 | 205 |
| 30 | 7858 | 7733 | 7610 | 7486 | 7363 | 206 |
| 40 | 7851 | 7725 | 7602 | 7478 | 7355 | 206 |
| 50 | 7844 | 7718 | 7594 | 7470 | 7347 | 207 |
| 60 0 | 9.997837 | 7711 | 7586 | 7462 | 7339 | 207 |
| 10 | 7830 | 7704 | 7579 | 7454 | 7330 | 208 |
| 20 | 7823 | 7696 | 7571 | 7446 | 7322 | 208 |
| 30 | 7817 | 7689 | 7564 | 7438 | 7314 | 209 |
| 40 | 7810 | 7682 | 7556 | 7430 | 7306 | 210 |
| 50 | 7803 | 7675 | 7549 | 7422 | 7297 | 211 |
| 61 0 | 9.997796 | 7667 | 7541 | 7414 | 7290 | 211 |
| 10 | 7789 | 7660 | 7534 | 7407 | 7281 | 212 |
| 20 | 7782 | 7653 | 7526 | 7399 | 7273 | 213 |
| 30 | 7775 | 7646 | 7519 | 7391 | 7265 | 214 |
| 40 | 7768 | 7638 | 7511 | 7383 | 7257 | 214 |
| 50 | 7761 | 7631 | 7504 | 7375 | 7248 | 215 |
| 62 0 | 9.997754 | 7624 | 7496 | 7367 | 7240 | 216 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 6 | |

# TABLE XXXIX.

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 23° | 24° | 25° | 26° | 27° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.997576 | 7468 | 7362 | 7256 | 7152 | 176 |
| 10 | 7568 | 7459 | 7353 | 7247 | 7142 | 177 |
| 20 | 7559 | 7450 | 7344 | 7238 | 7132 | 177 |
| 30 | 7550 | 7442 | 7334 | 7228 | 7122 | 178 |
| 40 | 7541 | 7433 | 7325 | 7218 | 7112 | 179 |
| 50 | 7533 | 7424 | 7316 | 7209 | 7102 | 179 |
| 54 0 | 9.997524 | 7415 | 7307 | 7199 | 7092 | 180 |
| 10 | 7516 | 7406 | 7297 | 7190 | 7082 | 180 |
| 20 | 7507 | 7397 | 7288 | 7180 | 7072 | 181 |
| 30 | 7499 | 7388 | 7279 | 7171 | 7063 | 182 |
| 40 | 7490 | 7380 | 7270 | 7161 | 7053 | 182 |
| 50 | 7482 | 7371 | 7260 | 7152 | 7043 | 183 |
| 55 0 | 9.997473 | 7362 | 7251 | 7142 | 7033 | 183 |
| 10 | 7464 | 7353 | 7242 | 7132 | 7023 | 184 |
| 20 | 7456 | 7344 | 7233 | 7123 | 7013 | 184 |
| 30 | 7447 | 7335 | 7223 | 7113 | 7003 | 185 |
| 40 | 7439 | 7326 | 7214 | 7103 | 6993 | 186 |
| 50 | 7430 | 7318 | 7205 | 7094 | 6983 | 186 |
| 56 0 | 9.997421 | 7309 | 7196 | 7084 | 6973 | 187 |
| 10 | 7413 | 7300 | 7187 | 7075 | 6964 | 187 |
| 20 | 7404 | 7291 | 7177 | 7065 | 6954 | 188 |
| 30 | 7396 | 7282 | 7168 | 7056 | 6944 | 188 |
| 40 | 7387 | 7273 | 7159 | 7046 | 6934 | 189 |
| 50 | 7379 | 7264 | 7149 | 7037 | 6924 | 189 |
| 57 0 | 9.997370 | 7255 | 7140 | 7027 | 6914 | 190 |
| 10 | 7361 | 7246 | 7131 | 7018 | 6904 | 190 |
| 20 | 7353 | 7237 | 7122 | 7008 | 6894 | 191 |
| 30 | 7344 | 7228 | 7113 | 6999 | 6884 | 191 |
| 40 | 7336 | 7220 | 7103 | 6989 | 6875 | 192 |
| 50 | 7327 | 7211 | 7094 | 6980 | 6865 | 192 |
| 58 0 | 9.997319 | 7202 | 7085 | 6970 | 6855 | 193 |
| 10 | 7310 | 7193 | 7076 | 6961 | 6845 | 193 |
| 20 | 7302 | 7184 | 7066 | 6951 | 6835 | 194 |
| 30 | 7293 | 7175 | 7057 | 6942 | 6825 | 194 |
| 40 | 7284 | 7166 | 7048 | 6932 | 6815 | 195 |
| 50 | 7276 | 7157 | 7039 | 6923 | 6805 | 195 |
| 59 0 | 9.997267 | 7148 | 7029 | 6913 | 6795 | 196 |
| 10 | 7259 | 7139 | 7020 | 6904 | 6785 | 196 |
| 20 | 7250 | 7130 | 7011 | 6894 | 6775 | 197 |
| 30 | 7241 | 7122 | 7002 | 6884 | 6766 | 198 |
| 40 | 7233 | 7113 | 6992 | 6875 | 6756 | 198 |
| 50 | 7224 | 7104 | 6983 | 6865 | 6746 | 199 |
| 60 0 | 9.997216 | 7095 | 6974 | 6855 | 6726 | 199 |
| 10 | 7207 | 7086 | 6965 | 6846 | 6726 | 200 |
| 20 | 7199 | 7077 | 6955 | 6836 | 6716 | 201 |
| 30 | 7190 | 7068 | 6946 | 6827 | 6706 | 201 |
| 40 | 7182 | 7060 | 6937 | 6817 | 6696 | 202 |
| 50 | 7173 | 7051 | 6928 | 6808 | 6686 | 202 |
| 61 0 | 9.997164 | 7042 | 6918 | 6798 | 6676 | 203 |
| 10 | 7156 | 7033 | 6909 | 6788 | 6666 | 204 |
| 20 | 7147 | 7024 | 6900 | 6779 | 6657 | 205 |
| 30 | 7139 | 7015 | 6891 | 6769 | 6647 | 205 |
| 40 | 7130 | 7006 | 6882 | 6759 | 6637 | 206 |
| 50 | 7122 | 6997 | 6872 | 6749 | 6627 | 206 |
| 62 0 | 9.997113 | 6988 | 6863 | 6740 | 6617 | 207 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Diff. to 100″ |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | |

| Moon's Hor. Par. | App. Alt. Moon's Center. 28° | 29° | 30° | 31° | 32° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.997048 | 6945 | 6844 | 6743 | 6643 | 168 |
| 10 | 7038 | 6935 | 6833 | 6732 | 6632 | 169 |
| 20 | 7028 | 6924 | 6822 | 6721 | 6620 | 169 |
| 30 | 7017 | 6914 | 6812 | 6710 | 6609 | 170 |
| 40 | 7007 | 6903 | 6801 | 6699 | 6597 | 170 |
| 50 | 6997 | 6893 | 6790 | 6688 | 6586 | 171 |
| 54 0 | 9.996987 | 6882 | 6779 | 6676 | 6574 | 172 |
| 10 | 6977 | 6872 | 6768 | 6665 | 6563 | 172 |
| 20 | 6966 | 6861 | 6757 | 6654 | 6551 | 173 |
| 30 | 6956 | 6850 | 6746 | 6643 | 6540 | 173 |
| 40 | 6946 | 6840 | 6735 | 6632 | 6528 | 174 |
| 50 | 6936 | 6829 | 6724 | 6620 | 6517 | 174 |
| 55 0 | 9.996926 | 6819 | 6713 | 6609 | 6505 | 175 |
| 10 | 6916 | 6808 | 6703 | 6597 | 6494 | 176 |
| 20 | 6905 | 6798 | 6692 | 6586 | 6482 | 176 |
| 30 | 6895 | 6787 | 6681 | 6575 | 6471 | 177 |
| 40 | 6885 | 6776 | 6670 | 6564 | 6459 | 177 |
| 50 | 6875 | 6766 | 6659 | 6553 | 6448 | 178 |
| 56 0 | 9.996864 | 6755 | 6648 | 6541 | 6436 | 178 |
| 10 | 6854 | 6745 | 6638 | 6530 | 6425 | 179 |
| 20 | 6844 | 6734 | 6627 | 6519 | 6413 | 179 |
| 30 | 6834 | 6724 | 6616 | 6508 | 6402 | 180 |
| 40 | 6824 | 6713 | 6605 | 6497 | 6390 | 181 |
| 50 | 6813 | 6703 | 6594 | 6486 | 6379 | 181 |
| 57 0 | 9.996803 | 6692 | 6583 | 6474 | 6367 | 182 |
| 10 | 6793 | 6682 | 6573 | 6463 | 6356 | 182 |
| 20 | 6783 | 6671 | 6562 | 6452 | 6344 | 183 |
| 30 | 6772 | 6661 | 6551 | 6441 | 6333 | 184 |
| 40 | 6762 | 6650 | 6540 | 6430 | 6321 | 184 |
| 50 | 6752 | 6640 | 6529 | 6418 | 6310 | 185 |
| 58 0 | 9.996742 | 6629 | 6518 | 6407 | 6298 | 185 |
| 10 | 6731 | 6619 | 6508 | 6396 | 6287 | 186 |
| 20 | 6721 | 6608 | 6497 | 6385 | 6275 | 186 |
| 30 | 6711 | 6597 | 6486 | 6374 | 6264 | 187 |
| 40 | 6701 | 6587 | 6475 | 6362 | 6252 | 187 |
| 50 | 6690 | 6576 | 6464 | 6351 | 6241 | 188 |
| 59 0 | 9.996680 | 6566 | 6453 | 6340 | 6229 | 188 |
| 10 | 6670 | 6555 | 6442 | 6329 | 6218 | 189 |
| 20 | 6659 | 6544 | 6431 | 6318 | 6206 | 189 |
| 30 | 6649 | 6534 | 6420 | 6307 | 6195 | 190 |
| 40 | 6639 | 6523 | 6409 | 6295 | 6183 | 190 |
| 50 | 6629 | 6513 | 6398 | 6284 | 6172 | 191 |
| 60 0 | 9.996619 | 6502 | 6387 | 6273 | 6160 | 191 |
| 10 | 6608 | 6492 | 6377 | 6262 | 6149 | 192 |
| 20 | 6598 | 6481 | 6366 | 6251 | 6137 | 192 |
| 30 | 6588 | 6471 | 6355 | 6239 | 6126 | 193 |
| 40 | 6578 | 6460 | 6344 | 6228 | 6114 | 193 |
| 50 | 6567 | 6449 | 6333 | 6217 | 6103 | 194 |
| 61 0 | 9.996557 | 6439 | 6322 | 6206 | 6091 | 194 |
| 10 | 6547 | 6428 | 6312 | 6195 | 6080 | 195 |
| 20 | 6537 | 6418 | 6301 | 6184 | 6068 | 195 |
| 30 | 6526 | 6407 | 6290 | 6172 | 6057 | 196 |
| 40 | 6516 | 6397 | 6279 | 6161 | 6045 | 197 |
| 50 | 6506 | 6386 | 6268 | 6150 | 6034 | 197 |
| 62 0 | 9.996496 | 6376 | 6257 | 6139 | 6022 | 198 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | 10″ | Diff. to 100″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 10 | | |

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 33° | 34° | 35° | 36° | 37° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.996545 | 6447 | 6351 | 6256 | 6162 | 159 |
| 10 | 6533 | 6435 | 6338 | 6243 | 6149 | 159 |
| 20 | 6521 | 6423 | 6326 | 6230 | 6136 | 160 |
| 30 | 6509 | 6411 | 6314 | 6217 | 6123 | 161 |
| 40 | 6497 | 6399 | 6301 | 6205 | 6110 | 161 |
| 50 | 6485 | 6386 | 6289 | 6192 | 6097 | 162 |
| 54 0 | 9.996474 | 6374 | 6276 | 6179 | 6084 | 162 |
| 10 | 6462 | 6362 | 6264 | 6167 | 6071 | 163 |
| 20 | 6450 | 6350 | 6252 | 6154 | 6058 | 163 |
| 30 | 6438 | 6338 | 6239 | 6141 | 6045 | 164 |
| 40 | 6427 | 6326 | 6227 | 6128 | 6032 | 164 |
| 50 | 6415 | 6314 | 6214 | 6116 | 6019 | 165 |
| 55 0 | 9.996403 | 6302 | 6202 | 6103 | 6006 | 165 |
| 10 | 6391 | 6290 | 6189 | 6091 | 5993 | 166 |
| 20 | 6379 | 6277 | 6177 | 6079 | 5980 | 166 |
| 30 | 6368 | 6265 | 6165 | 6065 | 5967 | 167 |
| 40 | 6356 | 6253 | 6152 | 6052 | 5954 | 167 |
| 50 | 6344 | 6241 | 6140 | 6039 | 5941 | 168 |
| 56 0 | 9.996332 | 6229 | 6127 | 6027 | 5928 | 168 |
| 10 | 6321 | 6217 | 6115 | 6014 | 5915 | 169 |
| 20 | 6309 | 6205 | 6102 | 6001 | 5902 | 169 |
| 30 | 6297 | 6193 | 6090 | 5989 | 5889 | 170 |
| 40 | 6285 | 6180 | 6078 | 5976 | 5876 | 170 |
| 50 | 6273 | 6168 | 6065 | 5963 | 5863 | 171 |
| 57 0 | 9.996262 | 6156 | 6053 | 5950 | 5850 | 171 |
| 10 | 6249 | 6144 | 6040 | 5938 | 5837 | 172 |
| 20 | 6237 | 6132 | 6028 | 5925 | 5824 | 172 |
| 30 | 6226 | 6120 | 6015 | 5912 | 5811 | 173 |
| 40 | 6214 | 6108 | 6002 | 5900 | 5798 | 173 |
| 50 | 6202 | 6096 | 5991 | 5887 | 5785 | 174 |
| 58 0 | 9.996190 | 6084 | 5978 | 5874 | 5772 | 174 |
| 10 | 6178 | 6072 | 5966 | 5861 | 5759 | 175 |
| 20 | 6166 | 6060 | 5953 | 5849 | 5746 | 175 |
| 30 | 6155 | 6047 | 5941 | 5836 | 5733 | 176 |
| 40 | 6143 | 6035 | 5929 | 5823 | 5720 | 176 |
| 50 | 6132 | 6023 | 5916 | 5811 | 5707 | 177 |
| 59 0 | 9.996119 | 6011 | 5904 | 5798 | 5694 | 177 |
| 10 | 6107 | 5999 | 5891 | 5785 | 5680 | 178 |
| 20 | 6096 | 5987 | 5879 | 5772 | 5667 | 178 |
| 30 | 6084 | 5975 | 5866 | 5760 | 5654 | 179 |
| 40 | 6072 | 5962 | 5854 | 5747 | 5641 | 179 |
| 50 | 6060 | 5950 | 5842 | 5734 | 5628 | 180 |
| 60 0 | 9.996048 | 5938 | 5829 | 5721 | 5615 | 180 |
| 10 | 6037 | 5926 | 5817 | 5708 | 5602 | 181 |
| 20 | 6025 | 5914 | 5804 | 5695 | 5589 | 181 |
| 30 | 6013 | 5902 | 5792 | 5683 | 5576 | 182 |
| 40 | 6001 | 5890 | 5779 | 5671 | 5563 | 182 |
| 50 | 5989 | 5878 | 5767 | 5658 | 5550 | 183 |
| 61 0 | 9.995978 | 5866 | 5755 | 5645 | 5537 | 183 |
| 10 | 5966 | 5853 | 5742 | 5632 | 5524 | 184 |
| 20 | 5954 | 5841 | 5730 | 5620 | 5511 | 184 |
| 30 | 5943 | 5829 | 5717 | 5607 | 5498 | 185 |
| 40 | 5931 | 5817 | 5705 | 5594 | 5485 | 186 |
| 50 | 5919 | 5805 | 5693 | 5582 | 5472 | 187 |
| 62 0 | 9.995907 | 5793 | 5680 | 5569 | 5459 | 187 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | |

| Moon's Hor. Par. | App. Alt. Moon's Center. 38° | 39° | 40° | 41° | 42° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.996069 | 5977 | 5887 | 5798 | 5711 | 149 |
| 10 | 6056 | 5964 | 5873 | 5784 | 5697 | 150 |
| 20 | 6042 | 5950 | 5859 | 5770 | 5682 | 150 |
| 30 | 6029 | 5937 | 5846 | 5756 | 5668 | 151 |
| 40 | 6016 | 5923 | 5832 | 5741 | 5653 | 152 |
| 50 | 6003 | 5910 | 5818 | 5727 | 5639 | 152 |
| 54 0 | 9.995989 | 5896 | 5804 | 5713 | 5624 | 153 |
| 10 | 5976 | 5883 | 5790 | 5699 | 5610 | 153 |
| 20 | 5963 | 5869 | 5776 | 5685 | 5596 | 154 |
| 30 | 5950 | 5856 | 5762 | 5671 | 5581 | 154 |
| 40 | 5936 | 5842 | 5748 | 5657 | 5567 | 155 |
| 50 | 5923 | 5829 | 5735 | 5643 | 5552 | 155 |
| 55 0 | 9.995910 | 5815 | 5721 | 5628 | 5538 | 156 |
| 10 | 5896 | 5801 | 5707 | 5614 | 5523 | 156 |
| 20 | 5883 | 5788 | 5693 | 5600 | 5509 | 157 |
| 30 | 5870 | 5774 | 5679 | 5586 | 5494 | 157 |
| 40 | 5856 | 5761 | 5665 | 5572 | 5480 | 158 |
| 50 | 5843 | 5747 | 5652 | 5558 | 5465 | 158 |
| 56 0 | 9.995830 | 5733 | 5637 | 5544 | 5451 | 158 |
| 10 | 5816 | 5720 | 5623 | 5529 | 5437 | 159 |
| 20 | 5803 | 5706 | 5609 | 5515 | 5422 | 159 |
| 30 | 5790 | 5693 | 5596 | 5501 | 5408 | 160 |
| 40 | 5776 | 5679 | 5582 | 5487 | 5394 | 160 |
| 50 | 5763 | 5666 | 5568 | 5473 | 5379 | 161 |
| 57 0 | 9.995750 | 5652 | 5554 | 5459 | 5365 | 161 |
| 10 | 5736 | 5638 | 5541 | 5444 | 5350 | 162 |
| 20 | 5723 | 5625 | 5527 | 5430 | 5336 | 162 |
| 30 | 5710 | 5611 | 5513 | 5416 | 5321 | 162 |
| 40 | 5696 | 5597 | 5499 | 5402 | 5307 | 163 |
| 50 | 5683 | 5584 | 5485 | 5388 | 5292 | 163 |
| 58 0 | 9.995670 | 5570 | 5471 | 5374 | 5278 | 164 |
| 10 | 5656 | 5556 | 5457 | 5359 | 5263 | 164 |
| 20 | 5643 | 5543 | 5443 | 5345 | 5249 | 165 |
| 30 | 5630 | 5529 | 5429 | 5331 | 5234 | 165 |
| 40 | 5616 | 5516 | 5416 | 5317 | 5220 | 166 |
| 50 | 5603 | 5502 | 5402 | 5303 | 5205 | 166 |
| 59 0 | 9.995590 | 5488 | 5388 | 5289 | 5191 | 167 |
| 10 | 5576 | 5475 | 5374 | 5274 | 5177 | 167 |
| 20 | 5563 | 5461 | 5360 | 5260 | 5163 | 167 |
| 30 | 5550 | 5447 | 5346 | 5246 | 5148 | 168 |
| 40 | 5536 | 5434 | 5332 | 5232 | 5134 | 168 |
| 50 | 5523 | 5420 | 5318 | 5218 | 5119 | 168 |
| 60 0 | 9.995510 | 5407 | 5304 | 5204 | 5105 | 169 |
| 10 | 5496 | 5393 | 5291 | 5189 | 5090 | 169 |
| 20 | 5483 | 5379 | 5277 | 5175 | 5076 | 170 |
| 30 | 5470 | 5366 | 5263 | 5161 | 5061 | 170 |
| 40 | 5456 | 5352 | 5249 | 5147 | 5047 | 171 |
| 50 | 5443 | 5338 | 5235 | 5133 | 5032 | 171 |
| 61 0 | 9.995430 | 5325 | 5221 | 5119 | 5018 | 172 |
| 10 | 5416 | 5311 | 5207 | 5104 | 5003 | 172 |
| 20 | 5403 | 5297 | 5193 | 5090 | 4989 | 173 |
| 30 | 5390 | 5284 | 5180 | 5076 | 4974 | 173 |
| 40 | 5376 | 5270 | 5166 | 5062 | 4960 | 174 |
| 50 | 5363 | 5256 | 5152 | 5048 | 4945 | 174 |
| 62 0 | 9.995350 | 5243 | 5138 | 5033 | 4931 | 175 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 3 | 4 | 6 | 7 | 8 | 10 | 11 | 13 | |

# TABLE XXXIX.

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 43° | 44° | 45° | 46° | 47° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.995625 | 5540 | 5456 | 5374 | 5294 | 138 |
| 10 | 5610 | 5525 | 5441 | 5359 | 5279 | 138 |
| 20 | 5595 | 5510 | 5426 | 5344 | 5263 | 138 |
| 30 | 5581 | 5495 | 5410 | 5328 | 5247 | 139 |
| 40 | 5566 | 5480 | 5395 | 5313 | 5231 | 139 |
| 50 | 5551 | 5465 | 5380 | 5298 | 5216 | 139 |
| 54 0 | 9.995536 | 5450 | 5365 | 5282 | 5200 | 140 |
| 10 | 5522 | 5435 | 5350 | 5267 | 5184 | 140 |
| 20 | 5507 | 5420 | 5334 | 5251 | 5168 | 141 |
| 30 | 5492 | 5405 | 5319 | 5236 | 5153 | 141 |
| 40 | 5478 | 5390 | 5304 | 5220 | 5137 | 142 |
| 50 | 5463 | 5375 | 5289 | 5205 | 5121 | 142 |
| 55 0 | 9.995448 | 5360 | 5274 | 5189 | 5105 | 143 |
| 10 | 5434 | 5345 | 5258 | 5174 | 5089 | 143 |
| 20 | 5419 | 5331 | 5243 | 5158 | 5074 | 144 |
| 30 | 5404 | 5316 | 5228 | 5143 | 5058 | 144 |
| 40 | 5390 | 5301 | 5213 | 5127 | 5042 | 145 |
| 50 | 5375 | 5286 | 5197 | 5112 | 5026 | 145 |
| 56 0 | 9.995360 | 5271 | 5182 | 5096 | 5011 | 146 |
| 10 | 5346 | 5256 | 5167 | 5080 | 4995 | 146 |
| 20 | 5331 | 5241 | 5152 | 5065 | 4979 | 147 |
| 30 | 5316 | 5226 | 5136 | 5049 | 4964 | 147 |
| 40 | 5302 | 5211 | 5121 | 5034 | 4948 | 147 |
| 50 | 5287 | 5195 | 5106 | 5018 | 4932 | 148 |
| 57 0 | 9.995272 | 5181 | 5091 | 5003 | 4916 | 148 |
| 10 | 5258 | 5166 | 5076 | 4987 | 4901 | 149 |
| 20 | 5243 | 5151 | 5060 | 4972 | 4885 | 149 |
| 30 | 5228 | 5136 | 5045 | 4956 | 4869 | 150 |
| 40 | 5214 | 5121 | 5030 | 4941 | 4853 | 150 |
| 50 | 5199 | 5106 | 5015 | 4925 | 4837 | 151 |
| 58 0 | 9.995184 | 5091 | 5000 | 4910 | 4822 | 151 |
| 10 | 5169 | 5076 | 4984 | 4894 | 4806 | 152 |
| 20 | 5155 | 5061 | 4969 | 4879 | 4790 | 152 |
| 30 | 5140 | 5046 | 4954 | 4863 | 4775 | 152 |
| 40 | 5125 | 5031 | 4939 | 4848 | 4759 | 153 |
| 50 | 5110 | 5016 | 4923 | 4832 | 4743 | 153 |
| 59 0 | 9.995095 | 5001 | 4908 | 4817 | 4727 | 153 |
| 10 | 5081 | 4986 | 4893 | 4801 | 4712 | 154 |
| 20 | 5066 | 4971 | 4878 | 4786 | 4696 | 154 |
| 30 | 5051 | 4956 | 4862 | 4770 | 4680 | 155 |
| 40 | 5037 | 4941 | 4847 | 4755 | 4665 | 155 |
| 50 | 5022 | 4926 | 4832 | 4739 | 4649 | 156 |
| 60 0 | 9.995007 | 4911 | 4817 | 4724 | 4633 | 156 |
| 10 | 4993 | 4896 | 4801 | 4708 | 4617 | 157 |
| 20 | 4978 | 4881 | 4786 | 4693 | 4601 | 157 |
| 30 | 4963 | 4866 | 4771 | 4677 | 4586 | 157 |
| 40 | 4949 | 4851 | 4756 | 4662 | 4570 | 158 |
| 50 | 4934 | 4836 | 4740 | 4646 | 4554 | 158 |
| 61 0 | 9.994919 | 4821 | 4725 | 4631 | 4538 | 158 |
| 10 | 4904 | 4806 | 4710 | 4615 | 4523 | 159 |
| 20 | 4890 | 4791 | 4695 | 4600 | 4507 | 159 |
| 30 | 4875 | 4776 | 4679 | 4584 | 4491 | 160 |
| 40 | 4860 | 4761 | 4664 | 4569 | 4476 | 160 |
| 50 | 4845 | 4746 | 4649 | 4553 | 4460 | 161 |
| 62 0 | 9.994830 | 4731 | 4634 | 4538 | 4444 | 161 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 6 | 7 | 9 | 10 | 12 | 14 | |

| Moon's Hor. Par. | App. Alt. Moon's Center. 48° | 49° | 50° | 51° | 52° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.995215 | 5137 | 5061 | 4986 | 4913 | 126 |
| 10 | 5199 | 5121 | 5045 | 4969 | 4896 | 126 |
| 20 | 5183 | 5105 | 5028 | 4952 | 4880 | 127 |
| 30 | 5167 | 5089 | 5012 | 4936 | 4862 | 127 |
| 40 | 5151 | 5072 | 4995 | 4919 | 4846 | 127 |
| 50 | 5135 | 5056 | 4979 | 4902 | 4829 | 128 |
| 54 0 | 9.995119 | 5040 | 4962 | 4886 | 4812 | 128 |
| 10 | 5103 | 5024 | 4946 | 4869 | 4795 | 128 |
| 20 | 5087 | 5008 | 4930 | 4852 | 4778 | 129 |
| 30 | 5071 | 4991 | 4913 | 4836 | 4761 | 129 |
| 40 | 5055 | 4975 | 4897 | 4819 | 4744 | 130 |
| 50 | 5039 | 4959 | 4880 | 4802 | 4727 | 130 |
| 55 0 | 9.995023 | 4943 | 4864 | 4786 | 4710 | 131 |
| 10 | 5007 | 4926 | 4847 | 4769 | 4693 | 131 |
| 20 | 4991 | 4910 | 4831 | 4752 | 4676 | 131 |
| 30 | 4975 | 4894 | 4814 | 4736 | 4660 | 132 |
| 40 | 4959 | 4878 | 4798 | 4719 | 4643 | 132 |
| 50 | 4943 | 4861 | 4781 | 4702 | 4626 | 132 |
| 56 0 | 9.994927 | 4845 | 4765 | 4686 | 4609 | 133 |
| 10 | 4911 | 4829 | 4748 | 4669 | 4592 | 133 |
| 20 | 4895 | 4813 | 4732 | 4652 | 4575 | 133 |
| 30 | 4879 | 4796 | 4715 | 4636 | 4558 | 134 |
| 40 | 4863 | 4780 | 4699 | 4619 | 4541 | 134 |
| 50 | 4847 | 4764 | 4682 | 4602 | 4524 | 135 |
| 57 0 | 9.994831 | 4748 | 4666 | 4586 | 4507 | 135 |
| 10 | 4815 | 4731 | 4649 | 4569 | 4490 | 136 |
| 20 | 4799 | 4715 | 4633 | 4552 | 4473 | 136 |
| 30 | 4783 | 4699 | 4616 | 4536 | 4457 | 136 |
| 40 | 4767 | 4683 | 4600 | 4519 | 4440 | 137 |
| 50 | 4751 | 4666 | 4583 | 4502 | 4423 | 137 |
| 58 0 | 9.994735 | 4650 | 4567 | 4486 | 4406 | 137 |
| 10 | 4719 | 4634 | 4550 | 4469 | 4389 | 138 |
| 20 | 4703 | 4618 | 4534 | 4452 | 4372 | 138 |
| 30 | 4687 | 4601 | 4517 | 4436 | 4355 | 138 |
| 40 | 4671 | 4585 | 4501 | 4419 | 4338 | 139 |
| 50 | 4655 | 4569 | 4484 | 4402 | 4321 | 139 |
| 59 0 | 9.994639 | 4553 | 4468 | 4385 | 4304 | 140 |
| 10 | 4623 | 4536 | 4451 | 4369 | 4287 | 140 |
| 20 | 4607 | 4520 | 4435 | 4352 | 4270 | 141 |
| 30 | 4591 | 4504 | 4418 | 4335 | 4253 | 141 |
| 40 | 4575 | 4488 | 4402 | 4319 | 4236 | 142 |
| 50 | 4559 | 4472 | 4385 | 4302 | 4220 | 142 |
| 60 0 | 9.994543 | 4455 | 4369 | 4285 | 4203 | 142 |
| 10 | 4527 | 4439 | 4352 | 4269 | 4186 | 143 |
| 20 | 4511 | 4423 | 4336 | 4252 | 4169 | 143 |
| 30 | 4495 | 4407 | 4319 | 4235 | 4152 | 143 |
| 40 | 4479 | 4390 | 4303 | 4219 | 4135 | 144 |
| 50 | 4463 | 4374 | 4286 | 4202 | 4118 | 144 |
| 61 0 | 9.994447 | 4358 | 4270 | 4185 | 4101 | 145 |
| 10 | 4431 | 4342 | 4253 | 4168 | 4084 | 145 |
| 20 | 4415 | 4325 | 4237 | 4152 | 4067 | 145 |
| 30 | 4399 | 4309 | 4220 | 4135 | 4050 | 146 |
| 40 | 4383 | 4293 | 4204 | 4118 | 4033 | 146 |
| 50 | 4367 | 4277 | 4188 | 4101 | 4016 | 147 |
| 62 0 | 9.994351 | 4260 | 4171 | 4084 | 3999 | 147 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 5 | 7 | 8 | 10 | 12 | 13 | 15 | |

# TABLE XXXIX.

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 53° | 54° | 55° | 56° | 57° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.994842 | 4773 | 4705 | 4639 | 4574 | 112 |
| 10 | 4825 | 4756 | 4687 | 4621 | 4556 | 112 |
| 20 | 4808 | 4738 | 4670 | 4603 | 4538 | 112 |
| 30 | 4791 | 4721 | 4652 | 4586 | 4520 | 113 |
| 40 | 4774 | 4703 | 4635 | 4568 | 4502 | 113 |
| 50 | 4757 | 4686 | 4617 | 4550 | 4484 | 113 |
| 54 0 | 9.994739 | 4668 | 4599 | 4532 | 4466 | 114 |
| 10 | 4722 | 4651 | 4582 | 4514 | 4448 | 114 |
| 20 | 4705 | 4634 | 4564 | 4496 | 4430 | 114 |
| 30 | 4688 | 4617 | 4547 | 4479 | 4412 | 115 |
| 40 | 4671 | 4599 | 4529 | 4461 | 4394 | 115 |
| 50 | 4654 | 4582 | 4512 | 4443 | 4376 | 115 |
| 55 0 | 9.994637 | 4564 | 4494 | 4425 | 4358 | 116 |
| 10 | 4620 | 4547 | 4476 | 4408 | 4340 | 116 |
| 20 | 4602 | 4530 | 4459 | 4390 | 4322 | 117 |
| 30 | 4585 | 4512 | 4441 | 4372 | 4304 | 117 |
| 40 | 4568 | 4495 | 4423 | 4354 | 4286 | 117 |
| 50 | 4551 | 4478 | 4406 | 4337 | 4268 | 118 |
| 56 0 | 9.994534 | 4460 | 4388 | 4319 | 4250 | 118 |
| 10 | 4516 | 4443 | 4371 | 4301 | 4232 | 118 |
| 20 | 4499 | 4425 | 4353 | 4283 | 4214 | 119 |
| 30 | 4482 | 4408 | 4336 | 4265 | 4196 | 119 |
| 40 | 4465 | 4391 | 4318 | 4247 | 4180 | 120 |
| 50 | 4448 | 4373 | 4301 | 4230 | 4160 | 120 |
| 57 0 | 9.994431 | 4356 | 4283 | 4212 | 4142 | 121 |
| 10 | 4414 | 4339 | 4265 | 4194 | 4124 | 121 |
| 20 | 4397 | 4321 | 4248 | 4176 | 4106 | 121 |
| 30 | 4379 | 4304 | 4230 | 4158 | 4099 | 122 |
| 40 | 4362 | 4287 | 4213 | 4140 | 4070 | 122 |
| 50 | 4345 | 4269 | 4195 | 4123 | 4052 | 122 |
| 58 0 | 9.994328 | 4252 | 4178 | 4105 | 4034 | 123 |
| 10 | 4311 | 4234 | 4160 | 4087 | 4016 | 123 |
| 20 | 4294 | 4217 | 4142 | 4069 | 3998 | 123 |
| 30 | 4276 | 4200 | 4125 | 4051 | 3980 | 124 |
| 40 | 4259 | 4182 | 4107 | 4033 | 3962 | 124 |
| 50 | 4242 | 4165 | 4090 | 4016 | 3944 | 124 |
| 59 0 | 9.994225 | 4147 | 4072 | 3998 | 3926 | 125 |
| 10 | 4208 | 4130 | 4054 | 3980 | 3908 | 125 |
| 20 | 4191 | 4112 | 4037 | 3962 | 3890 | 125 |
| 30 | 4174 | 4095 | 4019 | 3944 | 3872 | 126 |
| 40 | 4156 | 4078 | 4002 | 3927 | 3854 | 126 |
| 50 | 4139 | 4061 | 3984 | 3909 | 3836 | 127 |
| 60 0 | 9.994122 | 4043 | 3967 | 3891 | 3818 | 127 |
| 10 | 4105 | 4026 | 3949 | 3873 | 3800 | 127 |
| 20 | 4088 | 4008 | 3931 | 3855 | 3782 | 128 |
| 30 | 4071 | 3991 | 3913 | 3837 | 3764 | 128 |
| 40 | 4054 | 3974 | 3896 | 3820 | 3746 | 128 |
| 50 | 4036 | 3957 | 3879 | 3802 | 3728 | 129 |
| 61 0 | 9.994019 | 3939 | 3860 | 3785 | 3710 | 129 |
| 10 | 4002 | 3921 | 3843 | 3766 | 3692 | 129 |
| 20 | 3985 | 3904 | 3825 | 3748 | 3674 | 130 |
| 30 | 3968 | 3886 | 3808 | 3731 | 3656 | 130 |
| 40 | 3951 | 3869 | 3790 | 3713 | 3638 | 130 |
| 50 | 3933 | 3851 | 3773 | 3695 | 3620 | 131 |
| 62 0 | 9.993916 | 3834 | 3755 | 3677 | 3602 | 131 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 5 | 7 | 9 | 11 | 13 | 14 | 16 | |

| Moon's Hor. Par. | App. Alt. Moon's Center. 58° | 59° | 60° | 61° | 62° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.994512 | 4451 | 4392 | 4335 | 4279 | 96 |
| 10 | 4494 | 4432 | 4374 | 4316 | 4260 | 97 |
| 20 | 4476 | 4414 | 4355 | 4297 | 4241 | 97 |
| 30 | 4458 | 4396 | 4337 | 4279 | 4222 | 97 |
| 40 | 4439 | 4377 | 4318 | 4260 | 4203 | 98 |
| 50 | 4421 | 4359 | 4300 | 4241 | 4184 | 98 |
| 54 0 | 9.994403 | 4341 | 4281 | 4222 | 4165 | 98 |
| 10 | 4385 | 4322 | 4263 | 4204 | 4146 | 99 |
| 20 | 4366 | 4304 | 4244 | 4185 | 4127 | 99 |
| 30 | 4348 | 4285 | 4225 | 4166 | 4109 | 99 |
| 40 | 4330 | 4267 | 4207 | 4147 | 4090 | 100 |
| 50 | 4312 | 4249 | 4188 | 4129 | 4071 | 100 |
| 55 0 | 9.994294 | 4230 | 4169 | 4110 | 4052 | 101 |
| 10 | 4275 | 4212 | 4151 | 4091 | 4033 | 101 |
| 20 | 4257 | 4194 | 4132 | 4072 | 4014 | 101 |
| 30 | 4239 | 4175 | 4114 | 4054 | 3995 | 102 |
| 40 | 4221 | 4157 | 4095 | 4035 | 3976 | 102 |
| 50 | 4203 | 4139 | 4077 | 4016 | 3957 | 102 |
| 56 0 | 9.994184 | 4120 | 4058 | 3997 | 3938 | 103 |
| 10 | 4166 | 4102 | 4039 | 3978 | 3919 | 103 |
| 20 | 4148 | 4083 | 4021 | 3959 | 3900 | 103 |
| 30 | 4130 | 4065 | 4002 | 3940 | 3882 | 104 |
| 40 | 4112 | 4046 | 3984 | 3922 | 3863 | 104 |
| 50 | 4093 | 4028 | 3965 | 3903 | 3844 | 104 |
| 57 0 | 9.994075 | 4009 | 3946 | 3885 | 3825 | 104 |
| 10 | 4057 | 3991 | 3928 | 3866 | 3806 | 105 |
| 20 | 4039 | 3973 | 3909 | 3847 | 3787 | 105 |
| 30 | 4021 | 3954 | 3891 | 3828 | 3768 | 105 |
| 40 | 4002 | 3936 | 3872 | 3810 | 3749 | 106 |
| 50 | 3984 | 3918 | 3854 | 3791 | 3730 | 106 |
| 58 0 | 9.993966 | 3899 | 3835 | 3772 | 3711 | 106 |
| 10 | 3948 | 3881 | 3816 | 3753 | 3692 | 107 |
| 20 | 3930 | 3863 | 3798 | 3735 | 3673 | 107 |
| 30 | 3911 | 3844 | 3779 | 3716 | 3654 | 107 |
| 40 | 3893 | 3826 | 3759 | 3697 | 3635 | 107 |
| 50 | 3875 | 3808 | 3742 | 3678 | 3616 | 108 |
| 59 0 | 9.993857 | 3789 | 3723 | 3660 | 3597 | 108 |
| 10 | 3839 | 3771 | 3705 | 3641 | 3579 | 108 |
| 20 | 3820 | 3753 | 3686 | 3622 | 3560 | 109 |
| 30 | 3802 | 3734 | 3668 | 3603 | 3541 | 109 |
| 40 | 3784 | 3716 | 3649 | 3584 | 3522 | 109 |
| 50 | 3766 | 3697 | 3630 | 3566 | 3503 | 110 |
| 60 0 | 9.993748 | 3679 | 3612 | 3547 | 3484 | 110 |
| 10 | 3729 | 3660 | 3593 | 3528 | 3465 | 110 |
| 20 | 3711 | 3642 | 3574 | 3509 | 3446 | 111 |
| 30 | 3693 | 3623 | 3556 | 3490 | 3427 | 111 |
| 40 | 3675 | 3605 | 3537 | 3472 | 3408 | 111 |
| 50 | 3657 | 3587 | 3518 | 3453 | 3389 | 112 |
| 61 0 | 9.993638 | 3568 | 3500 | 3434 | 3370 | 112 |
| 10 | 3620 | 3550 | 3481 | 3415 | 3351 | 112 |
| 20 | 3602 | 3532 | 3462 | 3396 | 3332 | 113 |
| 30 | 3584 | 3513 | 3444 | 3378 | 3313 | 113 |
| 40 | 3566 | 3495 | 3425 | 3359 | 3294 | 113 |
| 50 | 3548 | 3477 | 3406 | 3340 | 3275 | 114 |
| 62 0 | 9.993529 | 3458 | 3388 | 3321 | 3256 | 114 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 7 | 9 | 11 | 13 | 15 | 17 | |

# TABLE XXXIX.

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 63° | 64° | 65° | 66° | 67° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.994224 | 4172 | 4121 | 4073 | 4027 | 82 |
| 10 | 4205 | 4153 | 4102 | 4053 | 4007 | 82 |
| 20 | 4166 | 4134 | 4083 | 4034 | 3987 | 83 |
| 30 | 4167 | 4114 | 4063 | 4014 | 3968 | 83 |
| 40 | 4148 | 4095 | 4044 | 3995 | 3948 | 83 |
| 50 | 4129 | 4076 | 4025 | 3975 | 3928 | 84 |
| 54 0 | 9.994110 | 4057 | 4005 | 3956 | 3908 | 84 |
| 10 | 4091 | 4038 | 3986 | 3936 | 3889 | 84 |
| 20 | 4072 | 4018 | 3966 | 3917 | 3869 | 85 |
| 30 | 4053 | 3999 | 3947 | 3897 | 3849 | 85 |
| 40 | 4034 | 3980 | 3927 | 3877 | 3830 | 85 |
| 50 | 4015 | 3961 | 3908 | 3858 | 3810 | 86 |
| 55 0 | 9.993996 | 3941 | 3888 | 3838 | 3790 | 86 |
| 10 | 3977 | 3922 | 3869 | 3819 | 3770 | 86 |
| 20 | 3957 | 3903 | 3850 | 3799 | 3751 | 86 |
| 30 | 3938 | 3884 | 3830 | 3780 | 3731 | 87 |
| 40 | 3919 | 3864 | 3811 | 3760 | 3711 | 87 |
| 50 | 3900 | 3845 | 3791 | 3740 | 3692 | 87 |
| 56 0 | 9.993881 | 3826 | 3772 | 3721 | 3672 | 87 |
| 10 | 3862 | 3807 | 3753 | 3701 | 3652 | 88 |
| 20 | 3843 | 3787 | 3733 | 3682 | 3632 | 88 |
| 30 | 3824 | 3768 | 3714 | 3662 | 3613 | 88 |
| 40 | 3805 | 3749 | 3695 | 3642 | 3592 | 88 |
| 50 | 3786 | 3730 | 3675 | 3623 | 3573 | 89 |
| 57 0 | 9.993766 | 3710 | 3656 | 3603 | 3553 | 89 |
| 10 | 3747 | 3691 | 3636 | 3584 | 3534 | 89 |
| 20 | 3728 | 3672 | 3617 | 3564 | 3514 | 89 |
| 30 | 3709 | 3652 | 3598 | 3545 | 3494 | 90 |
| 40 | 3690 | 3633 | 3578 | 3525 | 3474 | 90 |
| 50 | 3671 | 3614 | 3559 | 3505 | 3455 | 90 |
| 58 0 | 9.993652 | 3594 | 3539 | 3486 | 3435 | 91 |
| 10 | 3632 | 3575 | 3520 | 3466 | 3415 | 91 |
| 20 | 3613 | 3556 | 3500 | 3447 | 3396 | 91 |
| 30 | 3594 | 3537 | 3481 | 3427 | 3376 | 91 |
| 40 | 3575 | 3517 | 3461 | 3407 | 3356 | 92 |
| 50 | 3556 | 3498 | 3442 | 3388 | 3336 | 92 |
| 59 0 | 9.993537 | 3479 | 3422 | 3368 | 3317 | 92 |
| 10 | 3518 | 3459 | 3403 | 3349 | 3297 | 92 |
| 20 | 3498 | 3440 | 3384 | 3329 | 3277 | 93 |
| 30 | 3479 | 3421 | 3364 | 3310 | 3258 | 93 |
| 40 | 3460 | 3402 | 3345 | 3290 | 3238 | 93 |
| 50 | 3441 | 3382 | 3325 | 3270 | 3218 | 93 |
| 60 0 | 9.993421 | 3363 | 3306 | 3251 | 3198 | 94 |
| 10 | 3402 | 3344 | 3286 | 3231 | 3179 | 94 |
| 20 | 3383 | 3324 | 3267 | 3212 | 3159 | 94 |
| 30 | 3364 | 3305 | 3248 | 3192 | 3139 | 94 |
| 40 | 3345 | 3286 | 3228 | 3172 | 3119 | 95 |
| 50 | 3326 | 3267 | 3209 | 3153 | 3100 | 95 |
| 61 0 | 9.993307 | 3247 | 3189 | 3133 | 3080 | 95 |
| 10 | 3288 | 3228 | 3170 | 3114 | 3060 | 95 |
| 20 | 3269 | 3209 | 3150 | 3094 | 3040 | 96 |
| 30 | 3249 | 3189 | 3131 | 3075 | 3021 | 96 |
| 40 | 3230 | 3170 | 3111 | 3055 | 3001 | 96 |
| 50 | 3211 | 3150 | 3092 | 3035 | 2981 | 97 |
| 62 0 | 9.993192 | 3131 | 3072 | 3015 | 2961 | 97 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 92 |

| Moon's Hor. Par. | App. Alt. Moon's Center. 68° | 69° | 70° | 71° | 72° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.993982 | 3939 | 3898 | 3858 | 3822 | 67 |
| 10 | 3962 | 3919 | 3878 | 3838 | 3802 | 67 |
| 20 | 3942 | 3899 | 3858 | 3817 | 3781 | 67 |
| 30 | 3922 | 3879 | 3838 | 3797 | 3761 | 67 |
| 40 | 3902 | 3859 | 3818 | 3777 | 3740 | 67 |
| 50 | 3882 | 3839 | 3798 | 3757 | 3720 | 67 |
| 54 0 | 9.993863 | 3818 | 3777 | 3737 | 3699 | 68 |
| 10 | 3843 | 3798 | 3757 | 3716 | 3679 | 68 |
| 20 | 3823 | 3778 | 3737 | 3696 | 3658 | 68 |
| 30 | 3803 | 3758 | 3717 | 3676 | 3638 | 68 |
| 40 | 3783 | 3738 | 3697 | 3656 | 3617 | 68 |
| 50 | 3763 | 3718 | 3677 | 3636 | 3597 | 68 |
| 55 0 | 9.993743 | 3698 | 3656 | 3615 | 3576 | 69 |
| 10 | 3724 | 3678 | 3636 | 3595 | 3556 | 69 |
| 20 | 3704 | 3658 | 3616 | 3575 | 3536 | 69 |
| 30 | 3684 | 3638 | 3596 | 3555 | 3515 | 69 |
| 40 | 3664 | 3618 | 3576 | 3535 | 3495 | 69 |
| 50 | 3644 | 3598 | 3556 | 3514 | 3475 | 70 |
| 56 0 | 9.993624 | 3578 | 3535 | 3494 | 3455 | 70 |
| 10 | 3604 | 3558 | 3515 | 3474 | 3434 | 70 |
| 20 | 3585 | 3538 | 3495 | 3454 | 3414 | 70 |
| 30 | 3565 | 3518 | 3475 | 3434 | 3394 | 70 |
| 40 | 3545 | 3498 | 3455 | 3413 | 3373 | 71 |
| 50 | 3525 | 3478 | 3435 | 3393 | 3353 | 71 |
| 57 0 | 9.993505 | 3458 | 3415 | 3373 | 3333 | 71 |
| 10 | 3485 | 3438 | 3394 | 3353 | 3312 | 71 |
| 20 | 3466 | 3418 | 3374 | 3332 | 3292 | 71 |
| 30 | 3446 | 3398 | 3354 | 3312 | 3272 | 72 |
| 40 | 3426 | 3378 | 3334 | 3292 | 3251 | 72 |
| 50 | 3406 | 3358 | 3314 | 3272 | 3231 | 72 |
| 58 0 | 9.993386 | 3338 | 3294 | 3251 | 3211 | 72 |
| 10 | 3366 | 3318 | 3273 | 3231 | 3190 | 72 |
| 20 | 3346 | 3298 | 3253 | 3211 | 3170 | 73 |
| 30 | 3326 | 3278 | 3233 | 3191 | 3149 | 73 |
| 40 | 3306 | 3258 | 3213 | 3170 | 3129 | 73 |
| 50 | 3286 | 3238 | 3193 | 3150 | 3108 | 73 |
| 59 0 | 9.993267 | 3218 | 3173 | 3130 | 3088 | 73 |
| 10 | 3247 | 3198 | 3152 | 3110 | 3068 | 74 |
| 20 | 3227 | 3178 | 3132 | 3089 | 3047 | 74 |
| 30 | 3207 | 3158 | 3112 | 3069 | 3027 | 74 |
| 40 | 3187 | 3138 | 3092 | 3049 | 3007 | 74 |
| 50 | 3167 | 3118 | 3072 | 3029 | 2986 | 75 |
| 60 0 | 9.993147 | 3098 | 3052 | 3008 | 2966 | 75 |
| 10 | 3127 | 3078 | 3031 | 2988 | 2946 | 75 |
| 20 | 3108 | 3058 | 3011 | 2968 | 2925 | 75 |
| 30 | 3088 | 3038 | 2991 | 2948 | 2905 | 76 |
| 40 | 3068 | 3018 | 2971 | 2927 | 2885 | 76 |
| 50 | 3048 | 2998 | 2951 | 2907 | 2864 | 76 |
| 61 0 | 9.993028 | 2978 | 2931 | 2887 | 2844 | 76 |
| 10 | 3008 | 2958 | 2910 | 2867 | 2824 | 76 |
| 20 | 2988 | 2938 | 2890 | 2846 | 2803 | 77 |
| 30 | 2968 | 2918 | 2870 | 2826 | 2783 | 77 |
| 40 | 2948 | 2898 | 2850 | 2806 | 2762 | 77 |
| 50 | 2928 | 2878 | 2830 | 2786 | 2742 | 77 |
| 62 0 | 9.992909 | 2858 | 2810 | 2765 | 2722 | 77 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 92 |

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## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 73° | 74° | 75° | 76° | 77° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.993788 | 3753 | 3721 | 3691 | 3664 | 52 |
| 10 | 3767 | 3732 | 3700 | 3670 | 3643 | 52 |
| 20 | 3746 | 3712 | 3680 | 3649 | 3623 | 52 |
| 30 | 3726 | 3691 | 3659 | 3629 | 3602 | 52 |
| 40 | 3705 | 3671 | 3636 | 3608 | 3581 | 52 |
| 50 | 3684 | 3650 | 3617 | 3587 | 3560 | 52 |
| 54 0 | 9.993664 | 3630 | 3597 | 3567 | 3540 | 52 |
| 10 | 3643 | 3609 | 3576 | 3546 | 3519 | 52 |
| 20 | 3623 | 3588 | 3555 | 3525 | 3498 | 52 |
| 30 | 3602 | 3568 | 3536 | 3505 | 3477 | 53 |
| 40 | 3582 | 3547 | 3514 | 3484 | 3456 | 53 |
| 50 | 3561 | 3526 | 3493 | 3463 | 3436 | 53 |
| 55 0 | 9.993541 | 3506 | 3473 | 3443 | 3415 | 53 |
| 10 | 3520 | 3485 | 3452 | 3422 | 3394 | 53 |
| 20 | 3500 | 3464 | 3431 | 3401 | 3373 | 53 |
| 30 | 3479 | 3444 | 3411 | 3380 | 3352 | 53 |
| 40 | 3459 | 3423 | 3390 | 3360 | 3331 | 54 |
| 50 | 3438 | 3402 | 3370 | 3339 | 3310 | 54 |
| 56 0 | 9.993418 | 3382 | 3349 | 3318 | 3289 | 54 |
| 10 | 3397 | 3361 | 3328 | 3297 | 3269 | 54 |
| 20 | 3377 | 3340 | 3307 | 3276 | 3248 | 54 |
| 30 | 3356 | 3320 | 3287 | 3255 | 3227 | 54 |
| 40 | 3336 | 3299 | 3266 | 3234 | 3206 | 54 |
| 50 | 3315 | 3278 | 3245 | 3214 | 3185 | 55 |
| 57 0 | 9.993295 | 3258 | 3225 | 3193 | 3164 | 55 |
| 10 | 3274 | 3237 | 3204 | 3172 | 3144 | 55 |
| 20 | 3254 | 3217 | 3183 | 3151 | 3123 | 55 |
| 30 | 3233 | 3196 | 3163 | 3131 | 3102 | 55 |
| 40 | 3213 | 3176 | 3142 | 3110 | 3081 | 55 |
| 50 | 3192 | 3155 | 3121 | 3089 | 3060 | 56 |
| 58 0 | 9.993172 | 3136 | 3101 | 3068 | 3039 | 56 |
| 10 | 3151 | 3114 | 3080 | 3047 | 3018 | 56 |
| 20 | 3131 | 3094 | 3060 | 3027 | 2997 | 56 |
| 30 | 3110 | 3073 | 3039 | 3006 | 2977 | 56 |
| 40 | 3090 | 3053 | 3018 | 2985 | 2956 | 56 |
| 50 | 3069 | 3032 | 2997 | 2964 | 2935 | 56 |
| 59 0 | 9.993049 | 3012 | 2977 | 2944 | 2914 | 57 |
| 10 | 3028 | 2991 | 2956 | 2923 | 2893 | 57 |
| 20 | 3008 | 2970 | 2935 | 2902 | 2872 | 57 |
| 30 | 2987 | 2950 | 2915 | 2881 | 2851 | 57 |
| 40 | 2967 | 2929 | 2894 | 2860 | 2830 | 57 |
| 50 | 2946 | 2908 | 2873 | 2840 | 2809 | 57 |
| 60 0 | 9.992926 | 2888 | 2853 | 2819 | 2788 | 58 |
| 10 | 2905 | 2867 | 2832 | 2798 | 2768 | 58 |
| 20 | 2885 | 2847 | 2811 | 2777 | 2747 | 58 |
| 30 | 2864 | 2826 | 2791 | 2756 | 2726 | 58 |
| 40 | 2844 | 2806 | 2770 | 2736 | 2705 | 58 |
| 50 | 2823 | 2785 | 2749 | 2715 | 2684 | 58 |
| 61 0 | 9.992803 | 2765 | 2729 | 2694 | 2663 | 58 |
| 10 | 2782 | 2744 | 2708 | 2673 | 2642 | 59 |
| 20 | 2762 | 2723 | 2687 | 2653 | 2621 | 59 |
| 30 | 2741 | 2703 | 2666 | 2632 | 2600 | 59 |
| 40 | 2721 | 2682 | 2645 | 2611 | 2580 | 59 |
| 50 | 2700 | 2661 | 2626 | 2590 | 2559 | 59 |
| 62 0 | 9.992680 | 2641 | 2604 | 2570 | 2538 | 59 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 17 | 19 | |

| Moon's Hor. Par. | App. Alt. Moon's Center. 78° | 79° | 80° | 81° | 82° | Diff. to 100′ |
|---|---|---|---|---|---|---|
| 53′ 0″ | 9.993640 | 3617 | 3595 | 3577 | 3560 | 33 |
| 10 | 3619 | 3596 | 3574 | 3556 | 3539 | 33 |
| 20 | 3598 | 3575 | 3553 | 3535 | 3518 | 33 |
| 30 | 3577 | 3554 | 3532 | 3513 | 3496 | 34 |
| 40 | 3556 | 3533 | 3511 | 3492 | 3475 | 34 |
| 50 | 3535 | 3512 | 3490 | 3471 | 3454 | 34 |
| 54 0 | 9.993514 | 3491 | 3469 | 3450 | 3433 | 34 |
| 10 | 3493 | 3470 | 3448 | 3429 | 3412 | 34 |
| 20 | 3472 | 3449 | 3427 | 3408 | 3390 | 34 |
| 30 | 3451 | 3428 | 3406 | 3387 | 3369 | 34 |
| 40 | 3430 | 3407 | 3385 | 3365 | 3348 | 35 |
| 50 | 3409 | 3386 | 3364 | 3344 | 3327 | 35 |
| 55 0 | 9.993388 | 3365 | 3343 | 3323 | 3306 | 35 |
| 10 | 3368 | 3344 | 3322 | 3302 | 3284 | 35 |
| 20 | 3347 | 3323 | 3301 | 3281 | 3263 | 35 |
| 30 | 3326 | 3302 | 3280 | 3260 | 3242 | 35 |
| 40 | 3305 | 3281 | 3259 | 3238 | 3221 | 35 |
| 50 | 3284 | 3260 | 3238 | 3217 | 3200 | 35 |
| 56 0 | 9.993263 | 3239 | 3217 | 3196 | 3178 | 36 |
| 10 | 3242 | 3218 | 3196 | 3175 | 3157 | 36 |
| 20 | 3221 | 3197 | 3175 | 3154 | 3136 | 36 |
| 30 | 3200 | 3176 | 3154 | 3133 | 3115 | 36 |
| 40 | 3179 | 3155 | 3133 | 3111 | 3094 | 36 |
| 50 | 3158 | 3134 | 3111 | 3090 | 3072 | 36 |
| 57 0 | 9.993137 | 3113 | 3090 | 3069 | 3051 | 36 |
| 10 | 3117 | 3092 | 3069 | 3048 | 3030 | 36 |
| 20 | 3096 | 3071 | 3048 | 3027 | 3009 | 36 |
| 30 | 3075 | 3050 | 3027 | 3006 | 2988 | 36 |
| 40 | 3054 | 3029 | 3006 | 2985 | 2966 | 37 |
| 50 | 3033 | 3008 | 2985 | 2964 | 2945 | 37 |
| 58 0 | 9.993012 | 2987 | 2964 | 2943 | 2924 | 37 |
| 10 | 2991 | 2966 | 2943 | 2921 | 2903 | 37 |
| 20 | 2970 | 2945 | 2922 | 2900 | 2881 | 37 |
| 30 | 2949 | 2924 | 2901 | 2879 | 2860 | 37 |
| 40 | 2928 | 2902 | 2880 | 2858 | 2839 | 37 |
| 50 | 2907 | 2881 | 2858 | 2837 | 2818 | 37 |
| 59 0 | 9.992886 | 2860 | 2837 | 2816 | 2797 | 37 |
| 10 | 2865 | 2839 | 2816 | 2795 | 2775 | 37 |
| 20 | 2844 | 2818 | 2795 | 2773 | 2754 | 37 |
| 30 | 2823 | 2797 | 2774 | 2752 | 2733 | 37 |
| 40 | 2802 | 2776 | 2752 | 2731 | 2712 | 38 |
| 50 | 2781 | 2755 | 2731 | 2710 | 2691 | 38 |
| 60 0 | 9.992760 | 2734 | 2710 | 2689 | 2669 | 38 |
| 10 | 2739 | 2713 | 2689 | 2668 | 2648 | 38 |
| 20 | 2718 | 2692 | 2668 | 2647 | 2627 | 38 |
| 30 | 2697 | 2671 | 2647 | 2626 | 2606 | 38 |
| 40 | 2676 | 2650 | 2626 | 2604 | 2585 | 38 |
| 50 | 2655 | 2629 | 2605 | 2563 | 2563 | 38 |
| 61 0 | 9.992634 | 2608 | 2584 | 2562 | 2542 | 38 |
| 10 | 2614 | 2587 | 2563 | 2541 | 2521 | 38 |
| 20 | 2593 | 2566 | 2542 | 2320 | 2500 | 38 |
| 30 | 2572 | 2545 | 2520 | 2499 | 2479 | 38 |
| 40 | 2551 | 2524 | 2499 | 2478 | 2457 | 38 |
| 50 | 2530 | 2503 | 2478 | 2456 | 2436 | 39 |
| 62 0 | 9.992509 | 2482 | 2457 | 2435 | 2415 | 39 |

| P. parts to sec. of par. | 1″ | 2″ | 3″ | 4″ | 5″ | 6″ | 7″ | 8″ | 9″ | Sub. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 17 | 19 | |

# TABLE XXXIX.

## LOGARITHMIC DIFFERENCE.

| Moon's Hor. Par. | App. Alt. Moon's Center. 83° | 84° | 85° | 86° | Diff. to 100′ | Moon's Hor. Par. | App. Alt. ☽'s Center. 87° | 88° | 89° |
|---|---|---|---|---|---|---|---|---|---|
| 53′ 0″ | 9.993545 | 3532 | 3521 | 3512 | 18 | 53′ 0″ | 9.993505 | 3499 | 3497 |
| 10 | 3523 | 3511 | 3500 | 3491 | 18 | 10 | 3483 | 3477 | 3475 |
| 20 | 3502 | 3489 | 3478 | 3469 | 18 | 20 | 3462 | 3456 | 3454 |
| 30 | 3481 | 3468 | 3457 | 3448 | 18 | 30 | 3441 | 3435 | 3432 |
| 40 | 3460 | 3447 | 3436 | 3427 | 18 | 40 | 3419 | 3413 | 3410 |
| 50 | 3439 | 3426 | 3415 | 3405 | 18 | 50 | 3398 | 3392 | 3389 |
| 54 0 | 9.993418 | 3405 | 3393 | 3384 | 18 | 54 0 | 9.993377 | 3371 | 3368 |
| 10 | 3397 | 3383 | 3372 | 3362 | 18 | 10 | 3355 | 3349 | 3346 |
| 20 | 3375 | 3362 | 3351 | 3341 | 18 | 20 | 3334 | 3328 | 3325 |
| 30 | 3354 | 3341 | 3329 | 3319 | 18 | 30 | 3313 | 3306 | 3303 |
| 40 | 3333 | 3320 | 3308 | 3298 | 18 | 40 | 3291 | 3285 | 3282 |
| 50 | 3312 | 3298 | 3287 | 3277 | 18 | 50 | 3270 | 3264 | 3261 |
| 55 0 | 9.993290 | 3277 | 3265 | 3255 | 18 | 55 0 | 9.993248 | 3242 | 3239 |
| 10 | 3269 | 3256 | 3244 | 3234 | 18 | 10 | 3227 | 3221 | 3218 |
| 20 | 3247 | 3234 | 3223 | 3213 | 18 | 20 | 3205 | 3199 | 3197 |
| 30 | 3226 | 3213 | 3201 | 3191 | 18 | 30 | 3184 | 3178 | 3175 |
| 40 | 3205 | 3192 | 3180 | 3170 | 18 | 40 | 3163 | 3156 | 3154 |
| 50 | 3184 | 3171 | 3159 | 3149 | 18 | 50 | 3141 | 3135 | 3132 |
| 56 0 | 9.993162 | 3149 | 3137 | 3127 | 19 | 56 0 | 9.993120 | 3114 | 3111 |
| 10 | 3141 | 3128 | 3116 | 3106 | 19 | 10 | 3098 | 3092 | 3090 |
| 20 | 3120 | 3106 | 3095 | 3085 | 19 | 20 | 3077 | 3071 | 3068 |
| 30 | 3098 | 3086 | 3073 | 3063 | 19 | 30 | 3056 | 3049 | 3047 |
| 40 | 3077 | 3064 | 3052 | 3042 | 19 | 40 | 3034 | 3028 | 3025 |
| 50 | 3056 | 3042 | 3031 | 3021 | 19 | 50 | 3013 | 3007 | 3004 |
| 57 0 | 9.993035 | 3021 | 3009 | 2999 | 19 | 57 0 | 9.992991 | 2985 | 2982 |
| 10 | 3013 | 2999 | 2988 | 2976 | 19 | 10 | 2970 | 2964 | 2961 |
| 20 | 2992 | 2978 | 2967 | 2957 | 19 | 20 | 2949 | 2943 | 2940 |
| 30 | 2971 | 2957 | 2946 | 2935 | 19 | 30 | 2927 | 2921 | 2918 |
| 40 | 2950 | 2936 | 2924 | 2914 | 19 | 40 | 2906 | 2900 | 2897 |
| 50 | 2928 | 2914 | 2903 | 2893 | 19 | 50 | 2885 | 2879 | 2876 |
| 58 0 | 9.992907 | 2893 | 2881 | 2871 | 19 | 58 0 | 9.992863 | 2857 | 2854 |
| 10 | 2886 | 2871 | 2860 | 2850 | 19 | 10 | 2842 | 2836 | 2833 |
| 20 | 2865 | 2850 | 2839 | 2829 | 19 | 20 | 2821 | 2814 | 2812 |
| 30 | 2843 | 2829 | 2817 | 2807 | 19 | 30 | 2799 | 2793 | 2791 |
| 40 | 2822 | 2807 | 2796 | 2786 | 19 | 40 | 2778 | 2771 | 2769 |
| 50 | 2801 | 2786 | 2775 | 2765 | 19 | 50 | 2757 | 2750 | 2748 |
| 59 0 | 9.992780 | 2765 | 2753 | 2743 | 19 | 59 0 | 9.992735 | 2729 | 2726 |
| 10 | 2758 | 2744 | 2732 | 2722 | 19 | 10 | 2714 | 2707 | 2705 |
| 20 | 2737 | 2722 | 2710 | 2771 | 19 | 20 | 2693 | 2686 | 2683 |
| 30 | 2716 | 2701 | 2690 | 2679 | 19 | 30 | 2671 | 2664 | 2662 |
| 40 | 2695 | 2680 | 2668 | 2658 | 19 | 40 | 2650 | 2643 | 2640 |
| 50 | 2673 | 2659 | 2647 | 2637 | 19 | 50 | 2629 | 2622 | 2619 |
| 60 0 | 9.992652 | 2638 | 2625 | 2615 | 19 | 60 0 | 9.992607 | 2600 | 2597 |
| 10 | 2631 | 2616 | 2604 | 2594 | 19 | 10 | 2586 | 2579 | 2576 |
| 20 | 2610 | 2595 | 2583 | 2573 | 19 | 20 | 2565 | 2558 | 2555 |
| 30 | 2588 | 2574 | 2561 | 2551 | 19 | 30 | 2543 | 2537 | 2533 |
| 40 | 2567 | 2552 | 2540 | 2530 | 19 | 40 | 2522 | 2515 | 2512 |
| 50 | 2546 | 2531 | 2519 | 2508 | 19 | 50 | 2501 | 2194 | 2490 |
| 61 0 | 9.992525 | 2510 | 2497 | 2487 | 19 | 61 0 | 9.992479 | 2472 | 2469 |
| 10 | 2503 | 2488 | 2476 | 2465 | 19 | 10 | 2458 | 2451 | 2448 |
| 20 | 2482 | 2467 | 2455 | 2444 | 19 | 20 | 2436 | 2430 | 2426 |
| 30 | 2461 | 2446 | 2433 | 2423 | 19 | 30 | 2415 | 2408 | 2405 |
| 40 | 2440 | 2424 | 2412 | 2401 | 19 | 40 | 2393 | 2387 | 2383 |
| 50 | 2418 | 2403 | 2391 | 2380 | 19 | 50 | 2372 | 2366 | 2362 |
| 62 0 | 9.992397 | 2382 | 2369 | 2358 | 19 | 62 0 | 9.992350 | 2344 | 2340 |

P. parts to sec. of par. { 1″ 2″ 3″ 4″ 5″ 6″ 7″ 8″ 9″ / 2 4 6 9 11 13 15 17 19 } Sub.

# TABLE XL*.

Correction of the Logarithmic Diff. when the Sun is observed.

| App. Alt. Sun. | Cor. Sub. | App. Alt. Sun. | Cor. Sub. |
|---|---|---|---|
| ° | | ° | |
| 3 | 28 | 44 | 13 |
| 4 | 19 | 46 | 14 |
| 5 | 14 | 48 | 14 |
| 6 | 11 | 49 | 14 |
| 7 | 9 | 50 | 15 |
| 8 | 8 | 52 | 15 |
| 9 | 7 | 54 | 15 |
| 10 | 7 | 55 | 16 |
| 12 | 6 | 56 | 16 |
| 14 | 6 | 58 | 16 |
| 16 | 7 | 60 | 16 |
| 18 | 7 | 62 | 16 |
| 20 | 8 | 63 | 17 |
| 21 | 8 | 64 | 17 |
| 22 | 8 | 66 | 17 |
| 24 | 8 | 68 | 17 |
| 25 | 8 | 69 | 18 |
| 26 | 9 | 70 | 18 |
| 28 | 9 | 72 | 18 |
| 29 | 10 | 74 | 18 |
| 30 | 10 | 76 | 18 |
| 32 | 10 | 78 | 18 |
| 33 | 11 | 79 | 18 |
| 34 | 11 | 80 | 18 |
| 36 | 11 | 81 | 18 |
| 37 | 12 | 82 | 18 |
| 38 | 12 | 84 | 19 |
| 40 | 12 | 86 | 19 |
| 41 | 13 | 88 | 19 |
| 42 | 13 | 90 | 19 |

# TABLE XLI.

Correction of the Logarithmic Diff. when a Star is observed.

| App. Alt. Star | Cor. Sub. | App. Alt. Star. | Cor. Sub. |
|---|---|---|---|
| ° | | ° | |
| 3 | 27 | 23 | 1 |
| 4 | 19 | 24 | 1 |
| 5 | 12 | 25 | 1 |
| 6 | 9 | 26 | 1 |
| 7 | 7 | 27 | 1 |
| 8 | 6 | 28 | 1 |
| 9 | 5 | 29 | 1 |
| 10 | 4 | 30 | 0 |
| 11 | 3 | 31 | 0 |
| 12 | 3 | 32 | 0 |
| 13 | 2 | 33 | 0 |
| 14 | 2 | 34 | 0 |
| 15 | 1 | 35 | 0 |
| 16 | 1 | 36 | 0 |
| 17 | 1 | 37 | 0 |
| 18 | 1 | 38 | 0 |
| 19 | 1 | 39 | 0 |
| 20 | 1 | 40 | 0 |
| 21 | 1 | to | |
| 22 | 1 | 90 | 0 |

# TABLE XLII.

## AMPLITUDES.

### DECLINATION.

| Lat. | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° | 11° | 12° | 13° | 14° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ |
| 1 | 1 0 | 2 0 | 3 0 | 4 0 | 5 0 | 6 0 | 7 0 | 8 0 | 9 0 | 10 0 | 11 0 | 12 0 | 13 0 | 14 0 |
| 3 | 1 0 | 2 0 | 3 0 | 4 0 | 5 0 | 6 0 | 7 1 | 8 1 | 9 1 | 10 1 | 11 1 | 12 1 | 13 1 | 14 1 |
| 5 | 1 0 | 2 0 | 3 1 | 4 1 | 5 1 | 6 1 | 7 2 | 8 2 | 9 2 | 10 2 | 11 3 | 12 3 | 13 3 | 14 3 |
| 7 | 1 0 | 2 1 | 3 1 | 4 2 | 5 2 | 6 3 | 7 3 | 8 4 | 9 4 | 10 5 | 11 5 | 12 5 | 13 6 | 14 6 |
| 9 | 1 1 | 2 1 | 3 2 | 4 3 | 5 4 | 6 5 | 7 5 | 8 6 | 9 7 | 10 8 | 11 8 | 12 9 | 13 10 | 14 11 |
| 10 | 1 1 | 2 2 | 3 3 | 4 4 | 5 5 | 6 6 | 7 6 | 8 8 | 9 9 | 10 10 | 11 11 | 12 11 | 13 12 | 14 13 |
| 11 | 1 1 | 2 2 | 3 3 | 4 4 | 5 6 | 6 7 | 7 7 | 8 9 | 9 10 | 10 11 | 11 13 | 12 13 | 13 15 | 14 16 |
| 12 | 1 1 | 2 3 | 3 4 | 4 5 | 5 7 | 6 8 | 7 9 | 8 11 | 9 12 | 10 13 | 11 15 | 12 16 | 13 18 | 14 19 |
| 13 | 1 2 | 2 3 | 3 5 | 4 6 | 5 8 | 6 10 | 7 11 | 8 13 | 9 14 | 10 16 | 11 18 | 12 19 | 13 21 | 14 23 |
| 14 | 1 2 | 2 4 | 3 6 | 4 7 | 5 9 | 6 11 | 7 13 | 8 15 | 9 17 | 10 19 | 11 20 | 12 22 | 13 24 | 14 26 |
| 15 | 1 2 | 2 4 | 3 6 | 4 8 | 5 11 | 6 13 | 7 15 | 8 17 | 9 19 | 10 21 | 11 24 | 12 26 | 13 28 | 14 30 |
| 16 | 1 2 | 2 5 | 3 7 | 4 10 | 5 12 | 6 15 | 7 17 | 8 19 | 9 22 | 10 24 | 11 27 | 12 29 | 13 32 | 14 35 |
| 17 | 1 3 | 2 5 | 3 8 | 4 11 | 5 14 | 6 17 | 7 19 | 8 22 | 9 25 | 10 28 | 11 31 | 12 33 | 13 36 | 14 39 |
| 18 | 1 3 | 2 6 | 3 9 | 4 12 | 5 15 | 6 19 | 7 22 | 8 25 | 9 28 | 10 31 | 11 34 | 12 38 | 13 41 | 14 44 |
| 19 | 1 3 | 2 7 | 3 10 | 4 14 | 5 17 | 6 21 | 7 24 | 8 28 | 9 31 | 10 35 | 11 39 | 12 42 | 13 46 | 14 49 |
| 20 | 1 4 | 2 8 | 3 12 | 4 15 | 5 19 | 6 23 | 7 27 | 8 31 | 9 35 | 10 39 | 11 43 | 12 47 | 13 51 | 14 55 |
| 21 | 1 4 | 2 9 | 3 13 | 4 17 | 5 21 | 6 26 | 7 30 | 8 34 | 9 39 | 10 43 | 11 48 | 12 52 | 13 57 | 15 1 |
| 22 | 1 5 | 2 9 | 3 14 | 4 19 | 5 24 | 6 28 | 7 33 | 8 38 | 9 43 | 10 48 | 11 53 | 12 57 | 14 2 | 15 7 |
| 23 | 1 5 | 2 10 | 3 16 | 4 21 | 5 26 | 6 31 | 7 36 | 8 42 | 9 47 | 10 52 | 11 58 | 13 3 | 14 9 | 15 14 |
| 24 | 1 6 | 2 11 | 3 17 | 4 23 | 5 28 | 6 34 | 7 40 | 8 46 | 9 52 | 10 57 | 12 3 | 13 9 | 14 15 | 15 21 |
| 25 | 1 6 | 2 12 | 3 19 | 4 25 | 5 31 | 6 37 | 7 44 | 8 50 | 9 56 | 11 3 | 12 9 | 13 16 | 14 22 | 15 29 |
| 26 | 1 7 | 2 14 | 3 20 | 4 27 | 5 34 | 6 41 | 7 48 | 8 54 | 10 1 | 11 8 | 12 15 | 13 22 | 14 30 | 15 37 |
| 27 | 1 7 | 2 15 | 3 22 | 4 29 | 5 37 | 6 44 | 7 52 | 8 59 | 10 7 | 11 14 | 12 22 | 13 30 | 14 37 | 15 45 |
| 28 | 1 8 | 2 16 | 3 24 | 4 32 | 5 40 | 6 48 | 7 56 | 9 4 | 10 12 | 11 21 | 12 29 | 13 37 | 14 46 | 15 54 |
| 29 | 1 9 | 2 17 | 3 26 | 4 34 | 5 43 | 6 52 | 8 1 | 9 9 | 10 18 | 11 27 | 12 36 | 13 45 | 14 54 | 16 3 |
| 30 | 1 9 | 2 19 | 3 28 | 4 37 | 5 47 | 6 56 | 8 5 | 9 15 | 10 24 | 11 34 | 12 44 | 13 53 | 15 3 | 16 13 |
| 31 | 1 10 | 2 20 | 3 30 | 4 40 | 5 50 | 7 0 | 8 10 | 9 21 | 10 31 | 11 41 | 12 52 | 14 2 | 15 13 | 16 24 |
| 32 | 1 11 | 2 22 | 3 32 | 4 43 | 5 54 | 7 5 | 8 16 | 9 27 | 10 38 | 11 49 | 13 0 | 14 11 | 15 23 | 16 34 |
| 33 | 1 12 | 2 23 | 3 35 | 4 46 | 5 58 | 7 10 | 8 21 | 9 33 | 10 45 | 11 57 | 13 9 | 14 21 | 15 34 | 16 46 |
| 34 | 1 12 | 2 25 | 3 37 | 4 50 | 6 2 | 7 15 | 8 27 | 9 40 | 10 53 | 12 5 | 13 18 | 14 31 | 15 45 | 16 58 |
| 35 | 1 13 | 2 27 | 3 40 | 4 53 | 6 6 | 7 20 | 8 33 | 9 47 | 11 1 | 12 14 | 13 28 | 14 42 | 15 56 | 17 11 |
| 36 | 1 14 | 2 28 | 3 43 | 4 57 | 6 11 | 7 25 | 8 40 | 9 54 | 11 9 | 12 24 | 13 39 | 14 54 | 16 9 | 17 24 |
| 37 | 1 15 | 2 30 | 3 45 | 5 1 | 6 16 | 7 31 | 8 47 | 10 2 | 11 18 | 12 33 | 13 49 | 15 5 | 16 22 | 17 38 |
| 38 | 1 16 | 2 32 | 3 48 | 5 5 | 6 21 | 7 37 | 8 54 | 10 10 | 11 27 | 12 44 | 14 1 | 15 18 | 16 35 | 17 53 |
| 39 | 1 17 | 2 34 | 3 52 | 5 9 | 6 26 | 7 44 | 9 1 | 10 19 | 11 37 | 12 55 | 14 13 | 15 31 | 16 50 | 18 8 |
| 40 | 1 18 | 2 37 | 3 55 | 5 13 | 6 32 | 7 51 | 9 9 | 10 28 | 11 47 | 13 6 | 14 25 | 15 45 | 17 5 | 18 25 |
| 41 | 1 20 | 2 39 | 3 59 | 5 18 | 6 38 | 7 58 | 9 18 | 10 38 | 11 58 | 13 18 | 14 39 | 15 59 | 17 20 | 18 42 |
| 42 | 1 21 | 2 42 | 4 2 | 5 23 | 6 44 | 8 5 | 9 26 | 10 48 | 12 9 | 13 31 | 14 53 | 16 15 | 17 37 | 19 0 |
| 43 | 1 22 | 2 44 | 4 6 | 5 28 | 6 51 | 8 13 | 9 36 | 10 58 | 12 21 | 13 44 | 15 7 | 16 31 | 17 55 | 19 19 |
| 44 | 1 23 | 2 47 | 4 10 | 5 34 | 6 58 | 8 21 | 9 45 | 11 9 | 12 34 | 13 58 | 15 23 | 16 48 | 18 13 | 19 39 |
| 45 | 1 25 | 2 50 | 4 15 | 5 40 | 7 5 | 8 30 | 9 55 | 11 21 | 12 47 | 14 13 | 15 39 | 17 6 | 18 33 | 20 0 |
| 46 | 1 26 | 2 53 | 4 19 | 5 46 | 7 12 | 8 39 | 10 6 | 11 33 | 13 1 | 14 29 | 15 57 | 17 25 | 18 54 | 20 23 |
| 47 | 1 28 | 2 56 | 4 24 | 5 52 | 7 21 | 8 49 | 10 18 | 11 46 | 13 16 | 14 45 | 16 15 | 17 45 | 19 16 | 20 47 |
| 48 | 1 30 | 2 59 | 4 29 | 5 59 | 7 29 | 8 59 | 10 30 | 12 0 | 13 31 | 15 2 | 16 34 | 18 6 | 19 39 | 21 12 |
| 49 | 1 31 | 3 3 | 4 35 | 6 6 | 7 38 | 9 10 | 10 42 | 12 15 | 13 48 | 15 21 | 16 54 | 18 29 | 20 3 | 21 38 |
| 50 | 1 33 | 3 7 | 4 40 | 6 14 | 7 48 | 9 22 | 10 56 | 12 30 | 14 5 | 15 40 | 17 16 | 18 52 | 20 29 | 22 7 |
| 51 | 1 35 | 3 11 | 4 46 | 6 22 | 7 58 | 9 34 | 11 10 | 12 47 | 14 24 | 16 1 | 17 39 | 19 17 | 20 57 | 22 36 |
| 52 | 1 37 | 3 15 | 4 53 | 6 30 | 8 8 | 9 47 | 11 25 | 13 4 | 14 43 | 16 23 | 18 3 | 19 44 | 21 26 | 23 8 |
| 53 | 1 40 | 3 19 | 4 59 | 6 39 | 8 20 | 10 0 | 11 41 | 13 22 | 15 4 | 16 46 | 18 29 | 20 13 | 21 57 | 23 42 |
| 54 | 1 42 | 3 24 | 5 7 | 6 49 | 8 32 | 10 15 | 11 58 | 13 42 | 15 26 | 17 11 | 18 57 | 20 43 | 22 30 | 24 18 |
| 55 | 1 45 | 3 29 | 5 14 | 6 59 | 8 44 | 10 30 | 12 16 | 14 3 | 15 50 | 17 37 | 19 26 | 21 15 | 23 5 | 24 57 |
| 56 | 1 47 | 3 35 | 5 22 | 7 10 | 8 58 | 10 46 | 12 35 | 14 25 | 16 15 | 18 5 | 19 57 | 21 50 | 23 43 | 25 38 |
| 57 | 1 50 | 3 40 | 5 31 | 7 22 | 9 13 | 11 4 | 12 56 | 14 48 | 16 42 | 18 36 | 20 30 | 22 26 | 24 24 | 26 22 |
| 58 | 1 53 | 3 47 | 5 40 | 7 34 | 9 28 | 11 23 | 13 18 | 15 14 | 17 10 | 19 8 | 21 6 | 23 6 | 25 7 | 27 10 |
| 59 | 1 57 | 3 53 | 5 50 | 7 47 | 9 45 | 11 43 | 13 41 | 15 41 | 17 41 | 19 42 | 21 45 | 23 49 | 25 54 | 28 1 |
| 60 | 2 0 | 4 0 | 6 0 | 8 1 | 10 2 | 12 4 | 14 6 | 16 10 | 18 14 | 20 19 | 22 26 | 24 34 | 26 44 | 28 56 |
| 61 | 2 4 | 4 8 | 6 12 | 8 16 | 10 21 | 12 27 | 14 34 | 16 41 | 18 49 | 20 59 | 23 11 | 25 24 | 27 39 | 29 56 |
| 62 | 2 8 | 4 16 | 6 24 | 8 33 | 10 42 | 12 52 | 15 3 | 17 15 | 19 28 | 21 42 | 23 59 | 26 17 | 28 38 | 31 1 |
| 63 | 2 12 | 4 25 | 6 37 | 8 50 | 11 4 | 13 19 | 15 34 | 17 51 | 20 9 | 22 29 | 24 51 | 27 15 | 29 42 | 32 12 |
| 64 | 2 17 | 4 34 | 6 51 | 9 9 | 11 28 | 13 48 | 16 8 | 18 31 | 20 54 | 23 20 | 25 48 | 28 19 | 30 52 | 33 30 |
| 65 | 2 22 | 4 44 | 7 7 | 9 30 | 11 54 | 14 19 | 16 46 | 19 14 | 21 44 | 24 16 | 26 50 | 29 28 | 32 10 | 34 55 |
| 66 | 2 28 | 4 55 | 7 24 | 9 53 | 12 22 | 14 54 | 17 26 | 20 1 | 22 37 | 25 16 | 27 59 | 30 45 | 33 35 | 36 30 |

## AMPLITUDES.

### DECLINATION.

| Lat. | 15° | 16° | 17° | 18° | 19° | 20° | 21° | 21° 30′ | 22° | 22° 30′ | 23° | 23° 28′ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ |
| 1 | 15 0 | 16 0 | 17 0 | 18 0 | 19 0 | 20 0 | 21 0 | 21 30 | 22 0 | 22 30 | 23 0 | 23 28 |
| 3 | 15 1 | 16 1 | 17 1 | 18 2 | 19 2 | 20 2 | 21 2 | 21 32 | 22 2 | 22 32 | 23 2 | 23 30 |
| 5 | 15 4 | 16 4 | 17 4 | 18 4 | 19 5 | 20 5 | 21 5 | 21 35 | 22 5 | 22 35 | 23 6 | 23 34 |
| 7 | 15 7 | 16 7 | 17 8 | 18 8 | 19 9 | 20 9 | 21 10 | 21 40 | 22 10 | 22 41 | 23 11 | 23 39 |
| 9 | 15 11 | 16 12 | 17 13 | 18 14 | 19 15 | 20 16 | 21 16 | 21 47 | 22 17 | 22 48 | 23 18 | 23 47 |
| 10 | 15 14 | 16 15 | 17 16 | 18 17 | 19 18 | 20 19 | 21 20 | 21 51 | 22 21 | 22 52 | 23 23 | 23 51 |
| 11 | 15 17 | 16 18 | 17 20 | 18 21 | 19 22 | 20 24 | 21 25 | 21 55 | 22 26 | 22 57 | 23 28 | 23 56 |
| 12 | 15 21 | 16 22 | 17 23 | 18 25 | 19 26 | 20 28 | 21 30 | 22 0 | 22 31 | 23 2 | 23 33 | 24 1 |
| 13 | 15 24 | 16 26 | 17 28 | 18 29 | 19 31 | 20 33 | 21 35 | 22 6 | 22 37 | 23 8 | 23 38 | 24 7 |
| 14 | 15 28 | 16 30 | 17 32 | 18 34 | 19 36 | 20 38 | 21 40 | 22 11 | 22 43 | 23 14 | 23 45 | 24 14 |
| 15 | 15 33 | 16 35 | 17 37 | 18 39 | 19 42 | 20 44 | 21 47 | 22 18 | 22 49 | 23 20 | 23 52 | 24 21 |
| 16 | 15 37 | 16 40 | 17 42 | 18 45 | 19 48 | 20 51 | 21 53 | 22 25 | 22 56 | 23 28 | 23 59 | 24 28 |
| 17 | 15 42 | 16 45 | 17 48 | 18 51 | 19 54 | 20 57 | 22 1 | 22 32 | 23 4 | 23 35 | 24 7 | 24 36 |
| 18 | 15 47 | 16 51 | 17 54 | 18 58 | 20 1 | 21 5 | 22 8 | 22 40 | 23 12 | 23 44 | 24 15 | 24 45 |
| 19 | 15 53 | 16 57 | 18 1 | 19 5 | 20 8 | 21 12 | 22 16 | 22 49 | 23 20 | 23 52 | 24 25 | 24 54 |
| 20 | 15 59 | 17 3 | 18 8 | 19 12 | 20 16 | 21 21 | 22 25 | 22 57 | 23 30 | 24 2 | 24 34 | 25 4 |
| 21 | 16 6 | 17 10 | 18 15 | 19 20 | 20 25 | 21 29 | 22 34 | 23 7 | 23 39 | 24 12 | 24 45 | 25 15 |
| 22 | 16 13 | 17 18 | 18 23 | 19 28 | 20 33 | 21 39 | 22 44 | 23 17 | 23 50 | 24 23 | 24 55 | 25 26 |
| 23 | 16 20 | 17 26 | 18 31 | 19 37 | 20 43 | 21 49 | 22 55 | 23 28 | 24 1 | 24 34 | 25 7 | 25 38 |
| 24 | 16 27 | 17 34 | 18 40 | 19 46 | 20 53 | 21 59 | 23 6 | 23 39 | 24 13 | 24 46 | 25 19 | 25 51 |
| 25 | 16 36 | 17 42 | 18 49 | 19 56 | 21 3 | 22 10 | 23 18 | 23 51 | 24 25 | 24 59 | 25 32 | 26 4 |
| 26 | 16 44 | 17 52 | 18 59 | 20 7 | 21 14 | 22 22 | 23 30 | 24 4 | 24 38 | 25 12 | 25 46 | 26 18 |
| 27 | 16 53 | 18 1 | 19 9 | 20 18 | 21 26 | 22 34 | 23 43 | 24 17 | 24 52 | 25 26 | 26 1 | 26 33 |
| 28 | 17 3 | 18 11 | 19 20 | 20 29 | 21 38 | 22 47 | 23 57 | 24 31 | 25 6 | 25 41 | 26 16 | 26 49 |
| 29 | 17 13 | 18 22 | 19 32 | 20 41 | 21 51 | 23 1 | 24 11 | 24 46 | 25 22 | 25 57 | 26 32 | 27 5 |
| 30 | 17 23 | 18 34 | 19 44 | 20 54 | 22 5 | 23 16 | 24 27 | 25 2 | 25 38 | 26 13 | 26 49 | 27 23 |
| 31 | 17 34 | 18 45 | 19 57 | 21 8 | 22 19 | 23 31 | 24 43 | 25 19 | 25 55 | 26 31 | 27 7 | 27 41 |
| 32 | 17 46 | 18 58 | 20 10 | 21 22 | 22 35 | 23 47 | 25 0 | 25 36 | 26 13 | 26 49 | 27 26 | 28 0 |
| 33 | 17 59 | 19 11 | 20 24 | 21 37 | 22 51 | 24 4 | 25 18 | 25 55 | 26 32 | 27 9 | 27 46 | 28 21 |
| 34 | 18 11 | 19 26 | 20 39 | 21 53 | 23 7 | 24 22 | 25 37 | 26 14 | 26 52 | 27 29 | 28 7 | 28 42 |
| 35 | 18 25 | 19 40 | 20 55 | 22 10 | 23 25 | 24 41 | 25 57 | 26 35 | 27 13 | 27 51 | 28 29 | 29 5 |
| 36 | 18 39 | 19 58 | 21 11 | 22 27 | 23 44 | 25 1 | 26 18 | 26 56 | 27 35 | 28 14 | 28 53 | 29 30 |
| 37 | 18 55 | 20 11 | 21 28 | 22 46 | 24 3 | 25 21 | 26 40 | 27 19 | 27 58 | 28 38 | 29 17 | 29 55 |
| 38 | 19 10 | 20 28 | 21 47 | 23 5 | 24 24 | 25 43 | 27 3 | 27 43 | 28 23 | 29 3 | 29 44 | 30 21 |
| 39 | 19 27 | 20 46 | 22 6 | 23 26 | 24 46 | 26 7 | 27 28 | 28 8 | 28 49 | 29 30 | 30 11 | 30 49 |
| 40 | 19 45 | 21 5 | 22 26 | 23 47 | 25 9 | 26 31 | 27 54 | 28 35 | 29 17 | 29 58 | 30 40 | 31 19 |
| 41 | 20 3 | 21 25 | 22 48 | 24 10 | 25 33 | 26 57 | 28 21 | 29 3 | 29 46 | 30 28 | 31 11 | 31 51 |
| 42 | 20 23 | 21 46 | 23 10 | 24 34 | 25 59 | 27 24 | 28 50 | 29 33 | 30 16 | 31 0 | 31 43 | 32 24 |
| 43 | 20 44 | 22 8 | 23 34 | 25 0 | 26 26 | 27 53 | 29 20 | 30 5 | 30 49 | 31 33 | 32 18 | 32 59 |
| 44 | 21 5 | 22 32 | 23 59 | 25 26 | 26 55 | 28 23 | 29 53 | 30 38 | 31 23 | 32 8 | 32 54 | 33 37 |
| 45 | 21 28 | 22 57 | 24 25 | 25 55 | 27 25 | 28 56 | 30 27 | 31 13 | 31 59 | 32 46 | 33 33 | 34 17 |
| 46 | 21 53 | 23 23 | 24 53 | 26 25 | 27 57 | 29 30 | 31 3 | 31 51 | 32 38 | 33 26 | 34 14 | 34 59 |
| 47 | 22 18 | 23 50 | 25 23 | 26 57 | 28 31 | 30 6 | 31 42 | 32 30 | 33 19 | 34 8 | 34 57 | 35 44 |
| 48 | 22 45 | 24 20 | 25 55 | 27 30 | 29 7 | 30 44 | 32 23 | 33 13 | 34 3 | 34 53 | 35 44 | 36 31 |
| 49 | 23 14 | 24 51 | 26 28 | 28 6 | 29 45 | 31 25 | 33 7 | 33 58 | 34 49 | 35 41 | 36 33 | 37 22 |
| 50 | 23 45 | 25 24 | 27 3 | 28 44 | 30 26 | 32 9 | 33 53 | 34 46 | 35 39 | 36 32 | 37 26 | 38 17 |
| 51 | 24 17 | 25 59 | 27 41 | 29 25 | 31 9 | 32 55 | 34 43 | 35 37 | 36 32 | 37 27 | 38 23 | 39 15 |
| 52 | 24 52 | 26 36 | 28 21 | 30 8 | 31 56 | 33 45 | 35 36 | 36 32 | 37 29 | 38 26 | 39 24 | 40 18 |
| 53 | 25 28 | 27 16 | 29 4 | 30 54 | 32 45 | 34 38 | 36 33 | 37 31 | 38 30 | 39 29 | 40 29 | 41 26 |
| 54 | 26 7 | 27 58 | 29 50 | 31 43 | 33 38 | 35 35 | 37 34 | 38 34 | 39 36 | 40 37 | 41 40 | 42 39 |
| 55 | 26 49 | 28 43 | 30 39 | 32 36 | 34 35 | 36 36 | 38 40 | 39 43 | 40 47 | 41 51 | 42 56 | 43 58 |
| 56 | 27 34 | 29 32 | 31 31 | 33 33 | 35 36 | 37 42 | 39 51 | 40 57 | 42 4 | 43 11 | 44 20 | 45 24 |
| 57 | 28 22 | 30 24 | 32 28 | 34 34 | 36 43 | 38 54 | 41 9 | 42 18 | 43 27 | 44 38 | 45 50 | 46 59 |
| 58 | 29 14 | 31 21 | 33 29 | 35 40 | 37 54 | 40 12 | 42 33 | 43 45 | 44 59 | 46 14 | 47 30 | 48 43 |
| 59 | 30 10 | 32 21 | 34 35 | 36 52 | 39 12 | 41 37 | 44 6 | 45 22 | 46 40 | 47 59 | 49 21 | 50 38 |
| 60 | 31 10 | 33 27 | 35 47 | 38 10 | 40 38 | 43 10 | 45 47 | 47 8 | 48 31 | 49 56 | 51 24 | 52 47 |
| 61 | 32 16 | 34 39 | 37 5 | 39 36 | 42 11 | 44 52 | 47 40 | 49 7 | 50 36 | 52 7 | 53 42 | 55 18 |
| 62 | 33 27 | 35 57 | 38 31 | 41 10 | 43 54 | 46 46 | 49 46 | 51 19 | 52 56 | 54 36 | 56 20 | 58 1 |
| 63 | 34 45 | 37 23 | 40 5 | 42 54 | 45 49 | 48 53 | 52 8 | 53 50 | 55 36 | 57 27 | 59 23 | 61 18 |
| 64 | 36 11 | 38 58 | 41 50 | 44 49 | 47 58 | 51 17 | 54 50 | 56 44 | 58 43 | 60 48 | 63 2 | 65 17 |
| 65 | 37 46 | 40 43 | 43 46 | 46 59 | 50 23 | 54 2 | 57 59 | 60 8 | 62 25 | 64 53 | 67 36 | 70 26 |
| 66 | 39 31 | 42 40 | 45 57 | 49 27 | 53 10 | 57 14 | 61 46 | 64 18 | 67 4 | 70 12 | 73 52 | 78 15 |

# TABLE XLIII.

## SEMIDIURNAL AND SEMINOCTURNAL ARCHES,

## For finding the Time of the Rising and Setting of a Celestial Object.

DECLINATION.

| Lat | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° | 11° | 12° | 13° | 14° | 15° | 16° | Lat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | ° |
| 1 | 6 00 | 6 00 | 6 00 | 6 00 | 6 00 | 6 00 | 6 00 | 6 01 | 6 01 | 6 01 | 6 01 | 6 01 | 6 01 | 6 01 | 6 01 | 6 01 | 1 |
| 2 | 6 00 | 6 00 | 6 00 | 6 01 | 6 01 | 6 01 | 6 01 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 6 03 | 6 03 | 6 03 | 2 |
| 3 | 6 00 | 6 01 | 6 01 | 6 01 | 6 02 | 6 02 | 6 02 | 6 03 | 6 03 | 6 04 | 6 04 | 6 04 | 6 05 | 6 05 | 6 05 | 6 06 | 3 |
| 4 | 6 00 | 6 01 | 6 01 | 6 02 | 6 02 | 6 03 | 6 03 | 6 04 | 6 04 | 6 05 | 6 05 | 6 06 | 6 06 | 6 07 | 6 08 | 6 08 | 4 |
| 5 | 6 01 | 6 01 | 6 02 | 6 02 | 6 03 | 6 03 | 6 04 | 6 05 | 6 06 | 6 06 | 6 07 | 6 08 | 6 09 | 6 10 | 6 11 | 6 12 | 5 |
| 6 | 6 01 | 6 02 | 6 02 | 6 03 | 6 04 | 6 04 | 6 05 | 6 06 | 6 07 | 6 08 | 6 09 | 6 10 | 6 11 | 6 12 | 6 13 | 6 14 | 6 |
| 7 | 6 01 | 6 02 | 6 03 | 6 04 | 6 05 | 6 06 | 6 07 | 6 08 | 6 09 | 6 10 | 6 11 | 6 12 | 6 13 | 6 14 | 6 15 | 6 16 | 7 |
| 8 | 6 01 | 6 02 | 6 03 | 6 04 | 6 05 | 6 06 | 6 07 | 6 09 | 6 10 | 6 11 | 6 12 | 6 13 | 6 14 | 6 15 | 6 16 | 6 18 | 8 |
| 9 | 6 01 | 6 02 | 6 03 | 6 04 | 6 06 | 6 07 | 6 08 | 6 09 | 6 11 | 6 12 | 6 13 | 6 14 | 6 16 | 6 17 | 6 18 | 6 19 | 9 |
| 10 | 6 01 | 6 02 | 6 03 | 6 05 | 6 06 | 6 07 | 6 09 | 6 10 | 6 12 | 6 13 | 6 14 | 6 16 | 6 17 | 6 18 | 6 20 | 6 21 | 10 |
| 11 | 6 01 | 6 02 | 6 03 | 6 05 | 6 06 | 6 08 | 6 09 | 6 11 | 6 12 | 6 14 | 6 15 | 6 16 | 6 18 | 6 20 | 6 21 | 6 23 | 11 |
| 12 | 6 01 | 6 02 | 6 04 | 6 05 | 6 07 | 6 08 | 6 10 | 6 11 | 6 13 | 6 14 | 6 16 | 6 17 | 6 19 | 6 20 | 6 22 | 6 24 | 12 |
| 13 | 6 01 | 6 02 | 6 04 | 6 05 | 6 07 | 6 09 | 6 10 | 6 12 | 6 13 | 6 15 | 6 16 | 6 18 | 6 20 | 6 21 | 6 23 | 6 25 | 13 |
| 14 | 6 01 | 6 02 | 6 04 | 6 06 | 6 07 | 6 09 | 6 11 | 6 12 | 6 14 | 6 16 | 6 17 | 6 19 | 6 21 | 6 22 | 6 24 | 6 26 | 14 |
| 15 | 6 01 | 6 02 | 6 04 | 6 06 | 6 08 | 6 09 | 6 11 | 6 13 | 6 15 | 6 16 | 6 18 | 6 20 | 6 22 | 6 23 | 6 25 | 6 27 | 15 |
| 16 | 6 01 | 6 02 | 6 04 | 6 06 | 6 08 | 6 10 | 6 12 | 6 13 | 6 15 | 6 17 | 6 19 | 6 21 | 6 23 | 6 24 | 6 26 | 6 28 | 16 |
| 17 | 6 01 | 6 02 | 6 04 | 6 06 | 6 08 | 6 10 | 6 12 | 6 14 | 6 16 | 6 18 | 6 20 | 6 22 | 6 24 | 6 25 | 6 27 | 6 29 | 17 |
| 18 | 6 01 | 6 03 | 6 04 | 6 06 | 6 08 | 6 10 | 6 12 | 6 14 | 6 16 | 6 18 | 6 20 | 6 22 | 6 24 | 6 26 | 6 28 | 6 30 | 18 |
| 19 | 6 01 | 6 03 | 6 04 | 6 06 | 6 08 | 6 10 | 6 12 | 6 14 | 6 16 | 6 18 | 6 20 | 6 22 | 6 24 | 6 26 | 6 28 | 6 31 | 19 |
| 20 | 6 01 | 6 03 | 6 04 | 6 06 | 6 08 | 6 10 | 6 12 | 6 14 | 6 16 | 6 18 | 6 20 | 6 23 | 6 25 | 6 27 | 6 29 | 6 32 | 20 |
| 21 | 6 02 | 6 03 | 6 05 | 6 06 | 6 08 | 6 10 | 6 12 | 6 14 | 6 16 | 6 18 | 6 21 | 6 23 | 6 25 | 6 27 | 6 30 | 6 33 | 21 |
| 22 | 6 02 | 6 03 | 6 05 | 6 06 | 6 08 | 6 10 | 6 13 | 6 15 | 6 17 | 6 19 | 6 21 | 6 23 | 6 26 | 6 28 | 6 31 | 6 34 | 22 |
| 23 | 6 02 | 6 03 | 6 05 | 6 07 | 6 09 | 6 11 | 6 13 | 6 15 | 6 17 | 6 19 | 6 22 | 6 24 | 6 26 | 6 29 | 6 32 | 6 35 | 23 |
| 24 | 6 02 | 6 04 | 6 05 | 6 07 | 6 09 | 6 11 | 6 13 | 6 15 | 6 17 | 6 20 | 6 22 | 6 24 | 6 27 | 6 30 | 6 33 | 6 36 | 24 |
| 25 | 6 02 | 6 04 | 6 06 | 6 07 | 6 09 | 6 11 | 6 13 | 6 16 | 6 18 | 6 20 | 6 23 | 6 25 | 6 28 | 6 31 | 6 34 | 6 37 | 25 |
| 26 | 6 02 | 6 04 | 6 06 | 6 08 | 6 10 | 6 12 | 6 14 | 6 16 | 6 19 | 6 21 | 6 23 | 6 26 | 6 29 | 6 32 | 6 35 | 6 38 | 26 |
| 27 | 6 02 | 6 04 | 6 06 | 6 08 | 6 10 | 6 12 | 6 14 | 6 17 | 6 19 | 6 21 | 6 24 | 6 27 | 6 29 | 6 32 | 6 36 | 6 39 | 27 |
| 28 | 6 02 | 6 04 | 6 06 | 6 09 | 6 11 | 6 13 | 6 15 | 6 17 | 6 20 | 6 22 | 6 25 | 6 27 | 6 30 | 6 33 | 6 36 | 6 40 | 28 |
| 29 | 6 02 | 6 04 | 6 07 | 6 09 | 6 11 | 6 13 | 6 16 | 6 18 | 6 20 | 6 23 | 6 25 | 6 28 | 6 31 | 6 34 | 6 37 | 6 41 | 29 |
| 30 | 6 02 | 6 05 | 6 07 | 6 09 | 6 12 | 6 14 | 6 16 | 6 19 | 6 21 | 6 23 | 6 26 | 6 29 | 6 31 | 6 35 | 6 38 | 6 42 | 30 |
| 31 | 6 02 | 6 05 | 6 07 | 6 10 | 6 12 | 6 14 | 6 17 | 6 19 | 6 22 | 6 24 | 6 27 | 6 29 | 6 32 | 6 36 | 6 39 | 6 43 | 31 |
| 32 | 6 02 | 6 05 | 6 08 | 6 10 | 6 13 | 6 15 | 6 18 | 6 20 | 6 23 | 6 25 | 6 28 | 6 31 | 6 33 | 6 36 | 6 40 | 6 44 | 32 |
| 33 | 6 03 | 6 05 | 6 08 | 6 10 | 6 13 | 6 16 | 6 18 | 6 21 | 6 24 | 6 26 | 6 29 | 6 32 | 6 34 | 6 37 | 6 40 | 6 45 | 33 |
| 34 | 6 03 | 6 05 | 6 08 | 6 11 | 6 14 | 6 16 | 6 19 | 6 22 | 6 25 | 6 27 | 6 30 | 6 33 | 6 36 | 6 39 | 6 42 | 6 45 | 34 |
| 35 | 6 03 | 6 06 | 6 08 | 6 11 | 6 14 | 6 17 | 6 20 | 6 23 | 6 25 | 6 28 | 6 31 | 6 34 | 6 37 | 6 40 | 6 43 | 6 46 | 35 |
| 36 | 6 03 | 6 06 | 6 09 | 6 12 | 6 15 | 6 18 | 6 20 | 6 23 | 6 26 | 6 29 | 6 32 | 6 35 | 6 39 | 6 42 | 6 45 | 6 48 | 36 |
| 37 | 6 03 | 6 06 | 6 09 | 6 12 | 6 15 | 6 18 | 6 21 | 6 24 | 6 27 | 6 31 | 6 34 | 6 37 | 6 40 | 6 43 | 6 47 | 6 50 | 37 |
| 38 | 6 03 | 6 06 | 6 09 | 6 13 | 6 16 | 6 19 | 6 22 | 6 25 | 6 28 | 6 32 | 6 35 | 6 38 | 6 42 | 6 45 | 6 48 | 6 52 | 38 |
| 39 | 6 03 | 6 06 | 6 10 | 6 13 | 6 16 | 6 20 | 6 23 | 6 26 | 6 29 | 6 33 | 6 36 | 6 40 | 6 43 | 6 47 | 6 50 | 6 54 | 39 |
| 40 | 6 03 | 6 07 | 6 10 | 6 13 | 6 17 | 6 20 | 6 24 | 6 27 | 6 31 | 6 34 | 6 38 | 6 41 | 6 45 | 6 48 | 6 52 | 6 56 | 40 |
| 41 | 6 03 | 6 07 | 6 10 | 6 14 | 6 17 | 6 21 | 6 25 | 6 28 | 6 32 | 6 35 | 6 39 | 6 43 | 6 46 | 6 50 | 6 54 | 6 58 | 41 |
| 42 | 6 04 | 6 07 | 6 11 | 6 14 | 6 18 | 6 22 | 6 25 | 6 29 | 6 33 | 6 37 | 6 40 | 6 44 | 6 48 | 6 52 | 6 56 | 7 00 | 42 |
| 43 | 6 04 | 6 07 | 6 11 | 6 15 | 6 19 | 6 22 | 6 26 | 6 30 | 6 34 | 6 38 | 6 42 | 6 46 | 6 50 | 6 54 | 6 58 | 7 02 | 43 |
| 44 | 6 04 | 6 08 | 6 12 | 6 15 | 6 19 | 6 23 | 6 27 | 6 31 | 6 35 | 6 39 | 6 43 | 6 47 | 6 52 | 6 56 | 7 00 | 7 04 | 44 |
| 45 | 6 04 | 6 08 | 6 12 | 6 16 | 6 20 | 6 24 | 6 28 | 6 32 | 6 36 | 6 41 | 6 45 | 6 49 | 6 53 | 6 58 | 7 02 | 7 07 | 45 |
| 46 | 6 04 | 6 08 | 6 12 | 6 17 | 6 21 | 6 25 | 6 29 | 6 33 | 6 38 | 6 42 | 6 46 | 6 51 | 6 55 | 7 00 | 7 04 | 7 09 | 46 |
| 47 | 6 04 | 6 09 | 6 13 | 6 17 | 6 22 | 6 26 | 6 30 | 6 35 | 6 39 | 6 44 | 6 48 | 6 53 | 6 57 | 7 02 | 7 07 | 7 12 | 47 |
| 48 | 6 01 | 6 09 | 6 13 | 6 18 | 6 22 | 6 27 | 6 31 | 6 36 | 6 41 | 6 45 | 6 50 | 6 55 | 6 59 | 7 04 | 7 09 | 7 14 | 48 |
| 49 | 6 05 | 6 09 | 6 14 | 6 18 | 6 23 | 6 28 | 6 32 | 6 37 | 6 42 | 6 47 | 6 52 | 6 57 | 7 02 | 7 07 | 7 12 | 7 17 | 49 |
| 50 | 6 05 | 6 10 | 6 14 | 6 19 | 6 24 | 6 29 | 6 34 | 6 39 | 6 44 | 6 49 | 6 54 | 6 59 | 7 04 | 7 09 | 7 14 | 7 20 | 50 |
| 51 | 6 05 | 6 10 | 6 15 | 6 20 | 6 25 | 6 30 | 6 35 | 6 40 | 6 45 | 6 50 | 6 56 | 7 01 | 7 06 | 7 12 | 7 17 | 7 23 | 51 |
| 52 | 6 05 | 6 10 | 6 15 | 6 21 | 6 26 | 6 31 | 6 36 | 6 41 | 6 47 | 6 52 | 6 58 | 7 03 | 7 09 | 7 14 | 7 20 | 7 26 | 52 |
| 53 | 6 05 | 6 11 | 6 16 | 6 21 | 6 27 | 6 32 | 6 38 | 6 43 | 6 49 | 6 54 | 7 00 | 7 06 | 7 11 | 7 17 | 7 23 | 7 29 | 53 |
| 54 | 6 06 | 6 11 | 6 17 | 6 22 | 6 28 | 6 33 | 6 39 | 6 45 | 6 50 | 6 56 | 7 02 | 7 08 | 7 14 | 7 20 | 7 27 | 7 33 | 54 |
| 55 | 6 06 | 6 11 | 6 17 | 6 23 | 6 29 | 6 35 | 6 40 | 6 46 | 6 52 | 6 58 | 7 04 | 7 11 | 7 17 | 7 23 | 7 30 | 7 37 | 55 |
| 56 | 6 06 | 6 12 | 6 18 | 6 24 | 6 30 | 6 36 | 6 42 | 6 48 | 6 54 | 7 01 | 7 07 | 7 13 | 7 20 | 7 27 | 7 34 | 7 41 | 56 |
| 57 | 6 06 | 6 12 | 6 19 | 6 25 | 6 31 | 6 37 | 6 44 | 6 50 | 6 56 | 7 03 | 7 10 | 7 16 | 7 23 | 7 30 | 7 37 | 7 45 | 57 |
| 58 | 6 06 | 6 13 | 6 19 | 6 26 | 6 32 | 6 39 | 6 45 | 6 52 | 6 59 | 7 06 | 7 12 | 7 20 | 7 27 | 7 34 | 7 42 | 7 49 | 58 |
| 59 | 6 07 | 6 13 | 6 20 | 6 27 | 6 33 | 6 40 | 6 47 | 6 54 | 7 01 | 7 08 | 7 16 | 7 23 | 7 30 | 7 38 | 7 46 | 7 54 | 59 |
| 60 | 6 07 | 6 14 | 6 21 | 6 28 | 6 35 | 6 42 | 6 49 | 6 56 | 7 04 | 7 11 | 7 19 | 7 26 | 7 34 | 7 42 | 7 51 | 7 59 | 60 |
| 61 | 6 07 | 6 14 | 6 22 | 6 29 | 6 36 | 6 44 | 6 51 | 6 59 | 7 06 | 7 14 | 7 22 | 7 30 | 7 38 | 7 47 | 7 56 | 8 05 | 61 |
| 62 | 6 08 | 6 15 | 6 23 | 6 30 | 6 38 | 6 46 | 6 53 | 7 01 | 7 09 | 7 17 | 7 26 | 7 34 | 7 43 | 7 52 | 8 01 | 8 11 | 62 |
| 63 | 6 08 | 6 16 | 6 24 | 6 32 | 6 40 | 6 48 | 6 56 | 7 04 | 7 12 | 7 21 | 7 30 | 7 39 | 7 48 | 7 57 | 8 07 | 8 17 | 63 |
| 64 | 6 08 | 6 16 | 6 25 | 6 33 | 6 41 | 6 50 | 6 58 | 7 07 | 7 16 | 7 25 | 7 34 | 7 43 | 7 53 | 8 03 | 8 13 | 8 24 | 64 |
| 65 | 6 09 | 6 17 | 6 26 | 6 34 | 6 43 | 6 52 | 7 01 | 7 10 | 7 19 | 7 29 | 7 39 | 7 48 | 7 59 | 8 09 | 8 20 | 8 32 | 65 |

# TABLE XLIII.

## SEMIDIURNAL AND SEMINOCTURNAL ARCHES,

## For finding the Time of the Rising and Setting of a Celestial Object.

DECLINATION.

| Lat | 17° | 18° | 19° | 20° | 21° | 22° | 23° | 24° | 25° | 26° | 27° | 28° | 29° | 30° | Lat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h m. | h. m. | h. m | ° |
| 1 | 6 01 | 6 01 | 6 01 | 6 01 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 6 02 | 1 |
| 3 | 6 04 | 6 04 | 6 04 | 6 04 | 6 05 | 6 05 | 6 05 | 6 05 | 6 06 | 6 06 | 6 06 | 6 06 | 6 07 | 6 07 | 3 |
| 5 | 6 06 | 6 07 | 6 07 | 6 07 | 6 08 | 6 08 | 6 09 | 6 09 | 6 09 | 6 10 | 6 10 | 6 11 | 6 11 | 6 12 | 5 |
| 7 | 6 09 | 6 09 | 6 10 | 6 10 | 6 11 | 6 11 | 6 12 | 6 13 | 6 13 | 6 14 | 6 14 | 6 15 | 6 16 | 6 16 | 7 |
| 9 | 6 11 | 6 12 | 6 13 | 6 13 | 6 14 | 6 15 | 6 15 | 6 16 | 6 17 | 6 18 | 6 19 | 6 19 | 6 20 | 6 21 | 9 |
| 10 | 6 12 | 6 13 | 6 14 | 6 15 | 6 16 | 6 16 | 6 17 | 6 18 | 6 19 | 6 20 | 6 21 | 6 22 | 6 22 | 6 23 | 10 |
| 11 | 6 14 | 6 14 | 6 15 | 6 16 | 6 17 | 6 18 | 6 19 | 6 20 | 6 21 | 6 22 | 6 23 | 6 24 | 6 25 | 6 26 | 11 |
| 12 | 6 15 | 6 16 | 6 17 | 6 18 | 6 19 | 6 20 | 6 21 | 6 22 | 6 23 | 6 24 | 6 25 | 6 26 | 6 27 | 6 28 | 12 |
| 13 | 6 16 | 6 17 | 6 18 | 6 19 | 6 20 | 6 21 | 6 22 | 6 24 | 6 25 | 6 26 | 6 27 | 6 28 | 6 29 | 6 31 | 13 |
| 14 | 6 17 | 6 19 | 6 20 | 6 21 | 6 22 | 6 23 | 6 24 | 6 25 | 6 27 | 6 28 | 6 29 | 6 30 | 6 32 | 6 33 | 14 |
| 15 | 6 19 | 6 20 | 6 21 | 6 22 | 6 24 | 6 25 | 6 26 | 6 27 | 6 29 | 6 30 | 6 31 | 6 33 | 6 34 | 6 36 | 15 |
| 16 | 6 20 | 6 21 | 6 23 | 6 24 | 6 25 | 6 27 | 6 28 | 6 29 | 6 31 | 6 32 | 6 34 | 6 35 | 6 37 | 6 38 | 16 |
| 17 | 6 21 | 6 23 | 6 24 | 6 26 | 6 27 | 6 28 | 6 30 | 6 31 | 6 33 | 6 34 | 6 36 | 6 37 | 6 39 | 6 41 | 17 |
| 18 | 6 23 | 6 24 | 6 26 | 6 27 | 6 29 | 6 30 | 6 32 | 6 33 | 6 35 | 6 36 | 6 38 | 6 40 | 6 41 | 6 43 | 18 |
| 19 | 6 24 | 6 26 | 6 27 | 6 29 | 6 30 | 6 32 | 6 34 | 6 35 | 6 37 | 6 39 | 6 40 | 6 42 | 6 44 | 6 46 | 19 |
| 20 | 6 26 | 6 27 | 6 29 | 6 30 | 6 32 | 6 34 | 6 36 | 6 37 | 6 39 | 6 41 | 6 43 | 6 45 | 6 47 | 6 49 | 20 |
| 21 | 6 27 | 6 29 | 6 30 | 6 32 | 6 34 | 6 36 | 6 38 | 6 39 | 6 41 | 6 43 | 6 45 | 6 47 | 6 49 | 6 51 | 21 |
| 22 | 6 28 | 6 30 | 6 32 | 6 34 | 6 36 | 6 38 | 6 39 | 6 41 | 6 43 | 6 45 | 6 48 | 6 50 | 6 52 | 6 54 | 22 |
| 23 | 6 30 | 6 32 | 6 34 | 6 36 | 6 38 | 6 39 | 6 42 | 6 44 | 6 46 | 6 48 | 6 50 | 6 52 | 6 54 | 6 57 | 23 |
| 24 | 6 31 | 6 33 | 6 35 | 6 37 | 6 39 | 6 41 | 6 44 | 6 46 | 6 48 | 6 50 | 6 52 | 6 55 | 6 57 | 7 00 | 24 |
| 25 | 6 33 | 6 35 | 6 37 | 6 39 | 6 41 | 6 43 | 6 46 | 6 48 | 6 50 | 6 53 | 6 55 | 6 57 | 7 00 | 7 02 | 25 |
| 26 | 6 34 | 6 36 | 6 39 | 6 41 | 6 43 | 6 45 | 6 48 | 6 50 | 6 53 | 6 55 | 6 58 | 7 00 | 7 03 | 7 05 | 26 |
| 27 | 6 36 | 6 38 | 6 40 | 6 43 | 6 45 | 6 48 | 6 50 | 6 52 | 6 55 | 6 58 | 7 00 | 7 03 | 7 06 | 7 08 | 27 |
| 28 | 6 37 | 6 40 | 6 42 | 6 45 | 6 47 | 6 50 | 6 52 | 6 55 | 6 57 | 7 00 | 7 03 | 7 06 | 7 09 | 7 11 | 28 |
| 29 | 6 39 | 6 42 | 6 44 | 6 47 | 6 49 | 6 52 | 6 54 | 6 57 | 7 00 | 7 03 | 7 06 | 7 09 | 7 12 | 7 15 | 29 |
| 30 | 6 41 | 6 43 | 6 46 | 6 49 | 6 51 | 6 54 | 6 57 | 7 00 | 7 02 | 7 05 | 7 08 | 7 11 | 7 15 | 7 18 | 30 |
| 31 | 6 42 | 6 45 | 6 48 | 6 51 | 6 53 | 6 56 | 6 59 | 7 02 | 7 05 | 7 08 | 7 11 | 7 14 | 7 18 | 7 21 | 31 |
| 32 | 6 44 | 6 47 | 6 50 | 6 53 | 6 56 | 6 58 | 7 01 | 7 05 | 7 08 | 7 11 | 7 14 | 7 18 | 7 21 | 7 25 | 32 |
| 33 | 6 46 | 6 49 | 6 52 | 6 55 | 6 58 | 7 01 | 7 04 | 7 07 | 7 11 | 7 14 | 7 17 | 7 21 | 7 24 | 7 28 | 33 |
| 34 | 6 48 | 6 51 | 6 54 | 6 57 | 7 00 | 7 03 | 7 07 | 7 10 | 7 13 | 7 17 | 7 20 | 7 24 | 7 28 | 7 32 | 34 |
| 35 | 6 49 | 6 53 | 6 56 | 6 59 | 7 02 | 7 06 | 7 09 | 7 13 | 7 16 | 7 20 | 7 24 | 7 27 | 7 31 | 7 35 | 35 |
| 36 | 6 51 | 6 55 | 6 58 | 7 01 | 7 05 | 7 08 | 7 12 | 7 16 | 7 19 | 7 23 | 7 27 | 7 31 | 7 35 | 7 39 | 36 |
| 37 | 6 53 | 6 57 | 7 00 | 7 04 | 7 07 | 7 11 | 7 15 | 7 18 | 7 22 | 7 26 | 7 30 | 7 34 | 7 39 | 7 43 | 37 |
| 38 | 6 55 | 6 59 | 7 02 | 7 06 | 7 10 | 7 14 | 7 17 | 7 21 | 7 25 | 7 30 | 7 34 | 7 38 | 7 43 | 7 47 | 38 |
| 39 | 6 57 | 7 01 | 7 05 | 7 09 | 7 12 | 7 16 | 7 20 | 7 25 | 7 29 | 7 33 | 7 37 | 7 42 | 7 47 | 7 51 | 39 |
| 40 | 6 59 | 7 03 | 7 07 | 7 11 | 7 15 | 7 19 | 7 23 | 7 28 | 7 32 | 7 37 | 7 41 | 7 46 | 7 51 | 7 56 | 40 |
| 41 | 7 02 | 7 06 | 7 10 | 7 14 | 7 18 | 7 22 | 7 27 | 7 31 | 7 36 | 7 40 | 7 45 | 7 50 | 7 55 | 8 00 | 41 |
| 42 | 7 04 | 7 08 | 7 12 | 7 17 | 7 21 | 7 25 | 7 30 | 7 35 | 7 39 | 7 44 | 7 49 | 7 55 | 8 00 | 8 05 | 42 |
| 43 | 7 06 | 7 11 | 7 15 | 7 19 | 7 24 | 7 29 | 7 33 | 7 38 | 7 43 | 7 48 | 7 53 | 7 59 | 8 04 | 8 10 | 43 |
| 44 | 7 09 | 7 13 | 7 18 | 7 22 | 7 27 | 7 32 | 7 37 | 7 42 | 7 47 | 7 52 | 7 58 | 8 04 | 8 09 | 8 16 | 44 |
| 45 | 7 11 | 7 16 | 7 21 | 7 25 | 7 30 | 7 35 | 7 40 | 7 46 | 7 51 | 7 57 | 8 03 | 8 08 | 8 15 | 8 21 | 45 |
| 46 | 7 14 | 7 19 | 7 24 | 7 29 | 7 34 | 7 39 | 7 44 | 7 50 | 7 55 | 8 01 | 8 07 | 8 14 | 8 20 | 8 27 | 46 |
| 47 | 7 17 | 7 22 | 7 27 | 7 32 | 7 37 | 7 43 | 7 48 | 7 54 | 8 00 | 8 06 | 8 12 | 8 19 | 8 26 | 8 33 | 47 |
| 48 | 7 19 | 7 25 | 7 30 | 7 35 | 7 41 | 7 47 | 7 53 | 7 59 | 8 05 | 8 11 | 8 18 | 8 25 | 8 32 | 8 40 | 48 |
| 49 | 7 22 | 7 28 | 7 33 | 7 39 | 7 45 | 7 51 | 7 57 | 8 03 | 8 10 | 8 17 | 8 24 | 8 31 | 8 38 | 8 46 | 49 |
| 50 | 7 25 | 7 31 | 7 37 | 7 43 | 7 49 | 7 55 | 8 02 | 8 08 | 8 15 | 8 22 | 8 30 | 8 37 | 8 45 | 8 54 | 50 |
| 51 | 7 29 | 7 35 | 7 41 | 7 47 | 7 53 | 8 00 | 8 06 | 8 13 | 8 21 | 8 28 | 8 36 | 8 44 | 8 53 | 9 02 | 51 |
| 52 | 7 32 | 7 38 | 7 45 | 7 51 | 7 58 | 8 05 | 8 12 | 8 19 | 8 27 | 8 35 | 8 43 | 8 52 | 9 01 | 9 11 | 52 |
| 53 | 7 36 | 7 42 | 7 49 | 7 56 | 8 02 | 8 10 | 8 17 | 8 25 | 8 33 | 8 41 | 8 50 | 9 00 | 9 09 | 9 20 | 53 |
| 54 | 7 40 | 7 46 | 7 53 | 8 00 | 8 08 | 8 15 | 8 23 | 8 31 | 8 40 | 8 49 | 8 58 | 9 08 | 9 19 | 9 30 | 54 |
| 55 | 7 44 | 7 51 | 7 58 | 8 05 | 8 13 | 8 21 | 8 29 | 8 38 | 8 47 | 8 57 | 9 07 | 9 18 | 9 29 | 9 42 | 55 |
| 56 | 7 48 | 7 55 | 8 03 | 8 11 | 8 19 | 8 27 | 8 36 | 8 45 | 8 55 | 9 05 | 9 16 | 9 28 | 9 41 | 9 55 | 56 |
| 57 | 7 52 | 8 00 | 8 08 | 8 16 | 8 25 | 8 34 | 8 43 | 8 53 | 9 04 | 9 15 | 9 27 | 9 40 | 9 54 | 10 11 | 57 |
| 58 | 7 57 | 8 05 | 8 14 | 8 22 | 8 32 | 8 41 | 8 51 | 9 02 | 9 13 | 9 25 | 9 38 | 9 53 | 10 10 | 10 30 | 58 |
| 59 | 8 02 | 8 11 | 8 20 | 8 29 | 8 39 | 8 49 | 9 00 | 9 11 | 9 24 | 9 37 | 9 52 | 10 09 | 10 29 | 10 56 | 59 |
| 60 | 8 08 | 8 17 | 8 26 | 8 36 | 8 47 | 8 58 | 9 09 | 9 22 | 9 35 | 9 51 | 10 08 | 10 28 | 10 55 | 12 00 | 60 |
| 61 | 8 14 | 8 24 | 8 34 | 8 44 | 8 55 | 9 07 | 9 20 | 9 31 | 9 49 | 10 07 | 10 27 | 10 54 | 12 00 | | 61 |
| 62 | 8 20 | 8 31 | 8 42 | 8 53 | 9 05 | 9 18 | 9 32 | 9 47 | 10 05 | 10 26 | 10 54 | 12 00 | | | 62 |
| 63 | 8 27 | 8 38 | 8 50 | 9 02 | 9 16 | 9 30 | 9 46 | 10 04 | 10 25 | 10 53 | 12 00 | | | | 63 |
| 64 | 8 35 | 8 47 | 9 00 | 9 13 | 9 28 | 9 44 | 10 02 | 10 24 | 10 52 | 12 00 | | | | | 64 |
| 65 | 8 44 | 8 57 | 9 10 | 9 25 | 9 42 | 10 00 | 10 22 | 10 51 | 12 00 | | | | | | 65 |

# TABLE XLIV.

## For finding the APPARENT TIME of the PRINCIPAL STAR's passing the MERIDIAN throughout the YEAR.

| | January. | | | | | | | | | | February. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | |
| | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. |
| *Algenib* ... | 5 | 17 | 4 | 56 | 4 | 34 | 4 | 12 | 3 | 51 | 3 | 30 | 3 | 5 | 2 | 46 | 2 | 26 | 2 | 6 | 1 | 47 | 1 | 28 |
| *Schedar* ... | 5 | 43 | 5 | 21 | 5 | 0 | 4 | 38 | 4 | 17 | 3 | 56 | 3 | 31 | 3 | 11 | 2 | 52 | 2 | 32 | 2 | 13 | 1 | 54 |
| *Polar Star.* | 6 | 10 | 5 | 48 | 5 | 27 | 5 | 5 | 4 | 44 | 4 | 23 | 3 | 58 | 3 | 38 | 3 | 18 | 2 | 59 | 2 | 40 | 2 | 21 |
| *Mirach*.... | 6 | 13 | 5 | 51 | 5 | 30 | 5 | 8 | 4 | 47 | 4 | 26 | 4 | 1 | 3 | 41 | 3 | 21 | 3 | 2 | 2 | 43 | 2 | 24 |
| *Achernar* .. | 6 | 44 | 6 | 22 | 6 | 1 | 5 | 39 | 5 | 18 | 4 | 57 | 4 | 32 | 4 | 12 | 3 | 52 | 3 | 32 | 3 | 13 | 2 | 55 |
| α ARIETIS ... | 7 | 10 | 6 | 48 | 6 | 27 | 6 | 5 | 5 | 44 | 5 | 23 | 4 | 58 | 4 | 38 | 4 | 18 | 3 | 58 | 3 | 39 | 3 | 20 |
| *Menkar* ... | 8 | 6 | 7 | 44 | 7 | 22 | 7 | 1 | 6 | 40 | 6 | 19 | 5 | 54 | 5 | 34 | 5 | 14 | 4 | 54 | 4 | 35 | 4 | 16 |
| *Algol* ..... | 8 | 10 | 7 | 48 | 7 | 26 | 7 | 5 | 6 | 43 | 6 | 22 | 5 | 58 | 5 | 37 | 5 | 17 | 4 | 58 | 4 | 39 | 4 | 20 |
| α Perseus... | 8 | 24 | 8 | 3 | 7 | 41 | 7 | 20 | 6 | 58 | 6 | 37 | 6 | 13 | 5 | 52 | 5 | 32 | 5 | 13 | 4 | 54 | 4 | 35 |
| ALDEBARAN | 9 | 38 | 9 | 16 | 8 | 54 | 8 | 33 | 8 | 12 | 7 | 51 | 7 | 27 | 7 | 6 | 6 | 46 | 6 | 27 | 6 | 8 | 5 | 49 |
| *Capella*.... | 10 | 16 | 9 | 54 | 9 | 32 | 9 | 11 | 8 | 49 | 8 | 29 | 8 | 4 | 7 | 44 | 7 | 24 | 7 | 5 | 6 | 46 | 6 | 27 |
| *Rigel* .,... | 10 | 18 | 9 | 56 | 9 | 34 | 9 | 13 | 8 | 52 | 8 | 32 | 8 | 7 | 7 | 47 | 7 | 27 | 7 | 7 | 6 | 48 | 6 | 29 |
| β Taurus.... | 10 | 37 | 10 | 5 | 9 | 44 | 9 | 22 | 9 | 1 | 8 | 40 | 8 | 16 | 7 | 56 | 7 | 36 | 7 | 16 | 6 | 57 | 6 | 38 |
| *Bellatrix* .. | 10 | 38 | 10 | 6 | 9 | 44 | 9 | 22 | 9 | 1 | 8 | 40 | 8 | 17 | 7 | 56 | 7 | 36 | 7 | 17 | 6 | 58 | 6 | 39 |
| δ Orion..... | 10 | 35 | 10 | 13 | 9 | 51 | 9 | 30 | 9 | 9 | 8 | 48 | 8 | 24 | 8 | 4 | 7 | 44 | 7 | 24 | 7 | 5 | 6 | 46 |
| ε Orion..... | 10 | 40 | 10 | 17 | 9 | 56 | 9 | 34 | 9 | 13 | 8 | 52 | 8 | 28 | 8 | 8 | 7 | 48 | 7 | 28 | 7 | 9 | 6 | 50 |
| α Columba.. | 10 | 46 | 10 | 24 | 10 | 2 | 9 | 40 | 9 | 19 | 8 | 58 | 8 | 34 | 8 | 14 | 7 | 54 | 7 | 35 | 7 | 15 | 6 | 56 |
| *Betelguese*. | 10 | 58 | 10 | 36 | 10 | 14 | 9 | 52 | 9 | 31 | 9 | 10 | 8 | 46 | 8 | 26 | 8 | 6 | 7 | 47 | 7 | 28 | 7 | 9 |
| *Canopus*... | 11 | 32 | 11 | 10 | 10 | 49 | 10 | 27 | 10 | 6 | 9 | 45 | 9 | 20 | 9 | 0 | 8 | 41 | 8 | 21 | 8 | 2 | 7 | 43 |
| *Sirius*..... | 11 | 50 | 11 | 28 | 11 | 6 | 10 | 44 | 10 | 23 | 10 | 2 | 9 | 37 | 9 | 17 | 8 | 58 | 8 | 39 | 8 | 19 | 8 | 0 |
| *Castor* .... | 12 | 36 | 12 | 14 | 11 | 52 | 11 | 30 | 11 | 9 | 10 | 48 | 10 | 28 | 10 | 8 | 9 | 48 | 9 | 28 | 9 | 5 | 8 | 46 |
| *Procyon*... | 12 | 42 | 12 | 20 | 11 | 58 | 11 | 37 | 11 | 16 | 10 | 55 | 10 | 30 | 10 | 10 | 9 | 50 | 9 | 30 | 9 | 12 | 8 | 53 |
| POLLUX ... | 12 | 47 | 12 | 25 | 12 | 3 | 11 | 41 | 11 | 20 | 10 | 59 | 10 | 34 | 10 | 14 | 9 | 54 | 9 | 35 | 9 | 16 | 8 | 57 |
| ξ Argo Navis | 13 | 10 | 12 | 48 | 12 | 26 | 12 | 4 | 11 | 43 | 11 | 22 | 10 | 57 | 10 | 37 | 10 | 17 | 9 | 58 | 9 | 38 | 9 | 20 |
| γ Argo Navis | 13 | 16 | 12 | 54 | 12 | 33 | 12 | 11 | 11 | 50 | 11 | 29 | 11 | 4 | 10 | 44 | 10 | 24 | 10 | 4 | 9 | 45 | 9 | 27 |
| δ Argo Navis | 13 | 52 | 13 | 30 | 13 | 8 | 12 | 47 | 12 | 25 | 12 | 4 | 11 | 40 | 11 | 20 | 11 | 0 | 10 | 40 | 10 | 21 | 10 | 2 |
| β Argo Navis | 14 | 23 | 14 | 1 | 13 | 39 | 13 | 18 | 12 | 57 | 12 | 36 | 12 | 11 | 11 | 51 | 11 | 31 | 11 | 12 | 10 | 52 | 10 | 33 |
| *Alphard* ... | 14 | 30 | 14 | 8 | 13 | 46 | 13 | 26 | 13 | 4 | 12 | 44 | 12 | 19 | 11 | 59 | 11 | 39 | 11 | 19 | 11 | 0 | 10 | 41 |
| REGULUS .. | 15 | 10 | 14 | 48 | 14 | 26 | 14 | 5 | 13 | 45 | 13 | 24 | 12 | 59 | 12 | 39 | 12 | 19 | 11 | 59 | 11 | 40 | 11 | 21 |
| β Ursa Major | 16 | 2 | 15 | 41 | 15 | 18 | 14 | 57 | 14 | 36 | 14 | 16 | 13 | 51 | 13 | 31 | 13 | 11 | 12 | 51 | 12 | 32 | 12 | 13 |
| *Dubhe* .... | 16 | 4 | 15 | 42 | 15 | 20 | 14 | 59 | 14 | 37 | 14 | 17 | 13 | 53 | 13 | 32 | 13 | 12 | 12 | 53 | 12 | 34 | 12 | 15 |
| *Deneb*..... | 16 | 51 | 16 | 29 | 16 | 7 | 15 | 46 | 15 | 25 | 15 | 4 | 14 | 40 | 14 | 20 | 14 | 0 | 13 | 40 | 13 | 21 | 13 | 2 |
| γ Ursa Major | 16 | 56 | 16 | 34 | 16 | 12 | 15 | 50 | 15 | 29 | 15 | 8 | 14 | 44 | 14 | 24 | 14 | 4 | 13 | 45 | 13 | 25 | 13 | 6 |
| α Crux ..... | 17 | 28 | 17 | 6 | 16 | 44 | 16 | 23 | 16 | 1 | 15 | 40 | 15 | 16 | 14 | 57 | 14 | 37 | 14 | 17 | 13 | 58 | 13 | 39 |
| γ Crux ..... | 17 | 33 | 17 | 11 | 16 | 49 | 16 | 27 | 16 | 6 | 15 | 45 | 15 | 20 | 15 | 1 | 14 | 41 | 14 | 22 | 14 | 2 | 13 | 43 |
| SPICA..... | 18 | 27 | 18 | 5 | 17 | 43 | 17 | 22 | 17 | 1 | 16 | 39 | 16 | 15 | 15 | 55 | 15 | 35 | 15 | 16 | 14 | 57 | 14 | 38 |
| *Benetnach* . | 18 | 52 | 18 | 30 | 18 | 8 | 17 | 46 | 17 | 25 | 17 | 4 | 16 | 39 | 16 | 19 | 15 | 59 | 15 | 40 | 15 | 22 | 15 | 2 |
| β Centaur... | 19 | 3 | 18 | 41 | 18 | 19 | 17 | 57 | 17 | 36 | 17 | 15 | 16 | 50 | 16 | 30 | 16 | 10 | 15 | 51 | 15 | 32 | 15 | 12 |
| α Draco..... | 19 | 11 | 18 | 49 | 18 | 27 | 18 | 6 | 17 | 44 | 17 | 23 | 16 | 59 | 16 | 38 | 16 | 18 | 15 | 59 | 15 | 40 | 15 | 21 |
| *Arcturus* .. | 19 | 19 | 18 | 56 | 18 | 35 | 18 | 13 | 17 | 52 | 17 | 31 | 17 | 6 | 16 | 46 | 16 | 26 | 16 | 7 | 15 | 48 | 15 | 29 |
| *Seginus* ... | 19 | 35 | 19 | 13 | 18 | 52 | 18 | 31 | 18 | 11 | 17 | 49 | 17 | 24 | 17 | 4 | 16 | 44 | 16 | 24 | 16 | 5 | 15 | 46 |
| α Centaur... | 19 | 38 | 19 | 16 | 18 | 56 | 18 | 34 | 18 | 13 | 17 | 52 | 17 | 27 | 17 | 7 | 16 | 47 | 16 | 27 | 16 | 8 | 15 | 49 |
| *Zubenesch* . | 19 | 51 | 19 | 29 | 19 | 7 | 18 | 47 | 18 | 26 | 18 | 5 | 17 | 40 | 17 | 20 | 17 | 0 | 16 | 40 | 16 | 21 | 16 | 2 |
| *Zubenelg* .. | 20 | 18 | 19 | 56 | 19 | 34 | 19 | 13 | 18 | 52 | 18 | 31 | 18 | 6 | 17 | 46 | 17 | 26 | 17 | 7 | 16 | 47 | 16 | 28 |
| *Alphacca* .. | 20 | 38 | 20 | 15 | 19 | 54 | 19 | 32 | 19 | 12 | 18 | 51 | 18 | 26 | 18 | 6 | 17 | 46 | 17 | 26 | 17 | 7 | 16 | 48 |
| α Serpens... | 20 | 46 | 20 | 24 | 20 | 2 | 19 | 42 | 19 | 21 | 18 | 59 | 18 | 34 | 18 | 14 | 17 | 54 | 17 | 35 | 17 | 16 | 16 | 57 |
| ANTARES .. | 21 | 29 | 21 | 7 | 20 | 45 | 20 | 23 | 20 | 2 | 19 | 42 | 19 | 17 | 18 | 57 | 18 | 37 | 18 | 18 | 17 | 58 | 17 | 39 |
| *Ras Algethi* | 22 | 17 | 21 | 55 | 21 | 33 | 21 | 11 | 20 | 50 | 20 | 29 | 20 | 5 | 19 | 45 | 19 | 25 | 19 | 6 | 18 | 41 | 18 | 28 |
| *Ras Alhague* | 22 | 37 | 22 | 15 | 21 | 53 | 21 | 32 | 21 | 10 | 20 | 49 | 20 | 26 | 20 | 5 | 19 | 46 | 19 | 26 | 19 | 7 | 18 | 48 |
| *Rastaban* .. | 23 | 3 | 22 | 41 | 22 | 19 | 21 | 57 | 21 | 36 | 21 | 15 | 20 | 50 | 20 | 29 | 20 | 11 | 19 | 52 | 19 | 33 | 19 | 14 |
| *Vega* ..... | 23 | 41 | 23 | 19 | 22 | 57 | 22 | 36 | 22 | 15 | 21 | 54 | 21 | 29 | 21 | 10 | 20 | 50 | 20 | 30 | 20 | 11 | 19 | 52 |
| α AQUILÆ ... | 0 | 56 | 0 | 34 | 0 | 13 | 23 | 47 | 23 | 26 | 23 | 5 | 22 | 40 | 22 | 21 | 22 | 0 | 21 | 41 | 21 | 22 | 21 | 3 |
| α Pavo ..... | 1 | 26 | 1 | 4 | 0 | 42 | 0 | 10 | 23 | 55 | 23 | 34 | 23 | 9 | 22 | 49 | 22 | 29 | 22 | 10 | 21 | 50 | 21 | 31 |
| *Deneb*..... | 1 | 50 | 1 | 28 | 1 | 6 | 0 | 44 | 0 | 23 | 0 | 2 | 23 | 33 | 23 | 13 | 22 | 54 | 22 | 34 | 22 | 14 | 21 | 55 |
| *Alderamin*. | 2 | 29 | 2 | 7 | 1 | 45 | 1 | 23 | 1 | 2 | 0 | 41 | 0 | 16 | 23 | 52 | 23 | 33 | 23 | 13 | 22 | 53 | 22 | 34 |
| α Aquarius.. | 3 | 10 | 2 | 48 | 2 | 27 | 2 | 6 | 1 | 44 | 1 | 23 | 0 | 59 | 0 | 38 | 0 | 18 | 23 | 55 | 23 | 36 | 23 | 17 |
| α Grux ..... | 3 | 10 | 2 | 48 | 2 | 27 | 2 | 6 | 1 | 45 | 1 | 24 | 0 | 59 | 0 | 39 | 0 | 19 | 23 | 55 | 23 | 36 | 23 | 17 |
| FOMALHAUT | 4 | 1 | 3 | 39 | 3 | 17 | 2 | 56 | 2 | 35 | 2 | 14 | 1 | 50 | 1 | 29 | 1 | 10 | 0 | 50 | 0 | 31 | 0 | 12 |
| *Scheat* .... | 4 | 8 | 3 | 46 | 3 | 25 | 3 | 3 | 2 | 42 | 2 | 22 | 1 | 57 | 1 | 37 | 1 | 17 | 0 | 57 | 0 | 38 | 0 | 19 |
| MARCAB... | 4 | 9 | 3 | 47 | 3 | 25 | 3 | 4 | 2 | 43 | 2 | 23 | 1 | 58 | 1 | 38 | 1 | 18 | 0 | 58 | 0 | 39 | 0 | 20 |
| *Alpheratz*.. | 5 | 13 | 4 | 51 | 4 | 29 | 4 | 7 | 3 | 46 | 3 | 25 | 3 | 0 | 2 | 41 | 2 | 21 | 2 | 1 | 1 | 42 | 1 | 23 |

# TABLE XLIV.

## For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

| | March. | | | | | | | | April. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | |
| | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. |
| *Algenib* ... | 1 | 16 | 0 | 57 | 0 | 39 | 0 | 21 | 0 | 2 | 23 | 40 | 23 | 18 | 23 | 1 | 22 | 43 | 22 | 24 | 22 | 6 | 21 | 47 |
| *Schedar* ... | 1 | 42 | 1 | 24 | 1 | 5 | 0 | 47 | 0 | 29 | 0 | 11 | 23 | 45 | 23 | 26 | 23 | 8 | 22 | 50 | 22 | 32 | 22 | 13 |
| *Polar Star.* | 2 | 9 | 1 | 50 | 1 | 32 | 1 | 14 | 0 | 55 | 0 | 37 | 0 | 15 | 23 | 53 | 23 | 35 | 23 | 16 | 22 | 58 | 22 | 39 |
| *Mirach*.... | 2 | 12 | 1 | 53 | 1 | 34 | 1 | 16 | 0 | 58 | 0 | 40 | 0 | 18 | 23 | 56 | 23 | 37 | 23 | 19 | 23 | 1 | 22 | 42 |
| *Achernar* .. | 2 | 43 | 2 | 24 | 2 | 6 | 1 | 48 | 1 | 29 | 1 | 11 | 0 | 49 | 0 | 31 | 0 | 13 | 23 | 50 | 23 | 32 | 23 | 13 |
| α ARIETIS... | 3 | 9 | 2 | 50 | 2 | 32 | 2 | 14 | 1 | 55 | 1 | 37 | 1 | 15 | 0 | 57 | 0 | 39 | 0 | 20 | 23 | 58 | 23 | 39 |
| *Menkar* ... | 4 | 4 | 3 | 45 | 3 | 27 | 3 | 9 | 2 | 51 | 2 | 33 | 2 | 11 | 1 | 53 | 1 | 35 | 1 | 16 | 0 | 58 | 0 | 39 |
| *Algol* ..... | 4 | 7 | 3 | 49 | 3 | 30 | 3 | 13 | 2 | 55 | 2 | 37 | 2 | 15 | 1 | 57 | 1 | 38 | 1 | 20 | 1 | 1 | 0 | 43 |
| α Persei.... | 4 | 22 | 4 | 4 | 3 | 45 | 3 | 28 | 3 | 10 | 2 | 52 | 2 | 30 | 2 | 12 | 1 | 53 | 1 | 35 | 1 | 16 | 0 | 58 |
| ALDEBARAN | 5 | 37 | 5 | 18 | 4 | 59 | 4 | 41 | 4 | 23 | 4 | 5 | 3 | 43 | 3 | 25 | 3 | 7 | 2 | 49 | 2 | 30 | 2 | 12 |
| *Capella*.... | 6 | 14 | 5 | 56 | 5 | 37 | 5 | 19 | 5 | 1 | 4 | 43 | 4 | 21 | 4 | 3 | 3 | 44 | 3 | 26 | 3 | 8 | 2 | 50 |
| *Rigel* ..... | 6 | 17 | 5 | 58 | 5 | 40 | 5 | 21 | 5 | 3 | 4 | 45 | 4 | 23 | 4 | 5 | 3 | 47 | 3 | 28 | 3 | 11 | 2 | 52 |
| β Taurus.... | 6 | 26 | 6 | 7 | 5 | 49 | 5 | 30 | 5 | 12 | 4 | 54 | 4 | 32 | 4 | 14 | 3 | 56 | 3 | 37 | 3 | 19 | 3 | 1 |
| *Bellatrix* .. | 6 | 26 | 6 | 8 | 5 | 49 | 5 | 31 | 5 | 13 | 4 | 55 | 4 | 33 | 4 | 16 | 3 | 56 | 3 | 38 | 3 | 19 | 3 | 2 |
| ϑ Orionis.... | 6 | 34 | 6 | 15 | 5 | 57 | 5 | 38 | 5 | 20 | 5 | 2 | 4 | 40 | 4 | 22 | 4 | 4 | 3 | 45 | 3 | 27 | 3 | 9 |
| ε Orionis.... | 6 | 38 | 6 | 19 | 6 | 1 | 5 | 43 | 5 | 24 | 5 | 6 | 4 | 44 | 4 | 26 | 4 | 8 | 3 | 49 | 3 | 31 | 3 | 12 |
| α Columbæ .. | 6 | 44 | 6 | 25 | 6 | 7 | 5 | 49 | 5 | 30 | 5 | 12 | 4 | 51 | 4 | 32 | 4 | 14 | 3 | 56 | 3 | 37 | 3 | 18 |
| *Betelguese* . | 6 | 56 | 6 | 38 | 6 | 19 | 6 | 1 | 5 | 43 | 5 | 25 | 5 | 3 | 5 | 45 | 4 | 26 | 4 | 8 | 3 | 49 | 3 | 31 |
| *Canopus*... | 7 | 31 | 7 | 12 | 6 | 54 | 6 | 35 | 6 | 17 | 5 | 59 | 5 | 37 | 5 | 19 | 5 | 1 | 4 | 42 | 4 | 24 | 4 | 5 |
| *Sirius*..... | 7 | 48 | 7 | 29 | 7 | 11 | 6 | 53 | 6 | 35 | 6 | 16 | 5 | 55 | 5 | 36 | 5 | 18 | 5 | 0 | 4 | 41 | 4 | 22 |
| *Castor* .... | 8 | 24 | 8 | 15 | 7 | 57 | 7 | 39 | 7 | 20 | 7 | 2 | 6 | 40 | 6 | 22 | 6 | 4 | 5 | 46 | 5 | 27 | 5 | 8 |
| *Procyon*... | 8 | 41 | 8 | 22 | 8 | 4 | 7 | 45 | 7 | 27 | 7 | 9 | 6 | 47 | 6 | 29 | 6 | 11 | 5 | 52 | 5 | 34 | 5 | 15 |
| POLLUX ... | 8 | 45 | 8 | 27 | 8 | 8 | 7 | 50 | 7 | 32 | 7 | 13 | 6 | 52 | 6 | 33 | 6 | 15 | 5 | 57 | 5 | 38 | 5 | 19 |
| ξ Argo Navis | 9 | 8 | 8 | 50 | 8 | 31 | 8 | 13 | 7 | 55 | 7 | 36 | 7 | 16 | 6 | 56 | 6 | 38 | 6 | 20 | 6 | 1 | 5 | 42 |
| γ Argo Navis | 9 | 15 | 8 | 56 | 8 | 38 | 8 | 20 | 8 | 1 | 7 | 43 | 7 | 21 | 7 | 3 | 6 | 45 | 6 | 26 | 6 | 8 | 5 | 49 |
| δ Argo Navis | 9 | 50 | 9 | 32 | 9 | 14 | 8 | 55 | 8 | 37 | 8 | 19 | 7 | 57 | 7 | 39 | 7 | 21 | 7 | 2 | 6 | 44 | 6 | 25 |
| β Argo Navis | 10 | 21 | 10 | 3 | 9 | 44 | 9 | 27 | 9 | 9 | 8 | 50 | 8 | 29 | 8 | 10 | 7 | 52 | 7 | 34 | 7 | 15 | 6 | 56 |
| *Alphard* ... | 10 | 29 | 10 | 10 | 9 | 52 | 9 | 34 | 9 | 16 | 8 | 58 | 8 | 36 | 8 | 18 | 8 | 0 | 7 | 41 | 7 | 23 | 7 | 4 |
| REGULUS .. | 11 | 9 | 10 | 50 | 10 | 32 | 10 | 13 | 9 | 56 | 9 | 38 | 9 | 16 | 8 | 58 | 8 | 40 | 8 | 21 | 8 | 3 | 7 | 44 |
| β Ursa Major | 12 | 1 | 11 | 42 | 11 | 24 | 11 | 5 | 10 | 47 | 10 | 29 | 10 | 7 | 9 | 50 | 9 | 32 | 9 | 13 | 8 | 55 | 8 | 36 |
| *Dubhe* .... | 12 | 2 | 11 | 44 | 11 | 25 | 11 | 7 | 10 | 49 | 10 | 31 | 10 | 9 | 9 | 52 | 9 | 33 | 9 | 15 | 8 | 56 | 8 | 38 |
| *Deneb*..... | 12 | 50 | 12 | 31 | 12 | 13 | 11 | 54 | 11 | 36 | 11 | 18 | 10 | 56 | 10 | 38 | 10 | 20 | 10 | 1 | 9 | 43 | 9 | 25 |
| γ Ursa Major | 12 | 54 | 12 | 36 | 12 | 17 | 11 | 59 | 11 | 41 | 11 | 22 | 11 | 1 | 10 | 42 | 10 | 24 | 10 | 8 | 9 | 47 | 9 | 29 |
| α Crux ..... | 13 | 27 | 13 | 8 | 12 | 50 | 12 | 31 | 12 | 13 | 11 | 55 | 11 | 33 | 11 | 15 | 10 | 57 | 10 | 38 | 10 | 20 | 10 | 1 |
| γ Crux ..... | 13 | 31 | 13 | 12 | 12 | 54 | 12 | 36 | 12 | 18 | 11 | 59 | 11 | 38 | 11 | 19 | 11 | 1 | 10 | 44 | 10 | 24 | 10 | 5 |
| SPICA..... | 14 | 26 | 14 | 7 | 13 | 49 | 13 | 30 | 13 | 12 | 12 | 54 | 12 | 32 | 12 | 14 | 11 | 56 | 11 | 38 | 11 | 19 | 11 | 0 |
| *Benetnach* . | 14 | 50 | 14 | 32 | 14 | 13 | 13 | 55 | 13 | 37 | 13 | 19 | 12 | 57 | 12 | 39 | 12 | 20 | 12 | 3 | 11 | 43 | 11 | 25 |
| β Centaur... | 15 | 1 | 14 | 42 | 14 | 24 | 14 | 6 | 13 | 48 | 13 | 29 | 13 | 8 | 12 | 49 | 12 | 31 | 12 | 13 | 11 | 54 | 11 | 35 |
| α Draconis.. | 15 | 9 | 14 | 51 | 14 | 32 | 14 | 14 | 13 | 56 | 13 | 38 | 13 | 16 | 12 | 58 | 12 | 39 | 12 | 21 | 12 | 2 | 11 | 44 |
| *Arcturus* .. | 15 | 17 | 14 | 59 | 14 | 40 | 14 | 22 | 14 | 4 | 13 | 46 | 13 | 24 | 13 | 6 | 12 | 47 | 12 | 29 | 12 | 10 | 11 | 52 |
| *Seginus* ... | 15 | 35 | 15 | 16 | 14 | 57 | 14 | 39 | 14 | 21 | 14 | 3 | 13 | 41 | 13 | 23 | 13 | 5 | 12 | 46 | 12 | 28 | 12 | 9 |
| α Centauri... | 15 | 38 | 15 | 19 | 15 | 0 | 14 | 43 | 14 | 24 | 14 | 6 | 13 | 44 | 13 | 26 | 13 | 8 | 12 | 49 | 12 | 31 | 12 | 12 |
| *Zubenesch* . | 15 | 51 | 15 | 32 | 15 | 13 | 14 | 55 | 14 | 37 | 14 | 19 | 13 | 57 | 13 | 39 | 13 | 21 | 13 | 2 | 12 | 44 | 12 | 25 |
| *Zubenelg* .. | 16 | 16 | 15 | 59 | 15 | 39 | 15 | 22 | 15 | 4 | 14 | 45 | 14 | 24 | 14 | 5 | 13 | 47 | 13 | 29 | 13 | 10 | 12 | 51 |
| *Alphacca* .. | 16 | 36 | 16 | 17 | 15 | 59 | 15 | 42 | 15 | 23 | 15 | 5 | 14 | 44 | 14 | 25 | 14 | 7 | 13 | 48 | 13 | 30 | 13 | 11 |
| α Serpentis... | 16 | 44 | 16 | 26 | 16 | 7 | 15 | 50 | 15 | 32 | 15 | 14 | 14 | 52 | 14 | 34 | 14 | 15 | 13 | 57 | 13 | 38 | 13 | 20 |
| ANTARES .. | 17 | 27 | 17 | 9 | 16 | 50 | 16 | 32 | 16 | 15 | 15 | 57 | 15 | 35 | 15 | 17 | 14 | 58 | 14 | 40 | 14 | 21 | 14 | 2 |
| *Ras Algethi* | 18 | 15 | 17 | 57 | 17 | 38 | 17 | 20 | 17 | 2 | 16 | 44 | 16 | 23 | 16 | 5 | 15 | 46 | 15 | 28 | 15 | 9 | 14 | 51 |
| *Ras Alhague* | 18 | 35 | 18 | 17 | 17 | 58 | 17 | 40 | 17 | 22 | 17 | 4 | 16 | 41 | 16 | 25 | 16 | 6 | 15 | 48 | 15 | 29 | 15 | 11 |
| *Rastaban* .. | 19 | 1 | 18 | 43 | 18 | 24 | 18 | 6 | 17 | 48 | 17 | 30 | 17 | 8 | 16 | 50 | 16 | 31 | 16 | 13 | 15 | 55 | 15 | 37 |
| *Vega* ..... | 19 | 48 | 19 | 31 | 19 | 13 | 18 | 54 | 18 | 36 | 18 | 18 | 17 | 46 | 17 | 28 | 17 | 10 | 16 | 51 | 16 | 33 | 16 | 14 |
| α AQUILÆ ... | 20 | 51 | 20 | 32 | 20 | 14 | 19 | 56 | 19 | 37 | 19 | 19 | 18 | 57 | 18 | 39 | 18 | 21 | 18 | 2 | 17 | 44 | 17 | 25 |
| α PAVO ..... | 21 | 20 | 21 | 2 | 20 | 43 | 20 | 25 | 20 | 7 | 19 | 48 | 19 | 27 | 19 | 8 | 18 | 50 | 18 | 32 | 18 | 13 | 17 | 54 |
| *Deneb*..... | 21 | 44 | 21 | 26 | 21 | 7 | 20 | 49 | 20 | 31 | 20 | 12 | 19 | 51 | 19 | 32 | 19 | 14 | 18 | 56 | 18 | 37 | 18 | 18 |
| *Alderamin*. | 22 | 23 | 22 | 5 | 21 | 45 | 21 | 28 | 21 | 10 | 20 | 51 | 20 | 30 | 20 | 11 | 19 | 53 | 19 | 35 | 19 | 16 | 18 | 57 |
| α Aquarius.. | 23 | 4 | 22 | 46 | 22 | 27 | 22 | 10 | 21 | 52 | 21 | 34 | 21 | 12 | 20 | 54 | 20 | 35 | 20 | 17 | 19 | 58 | 19 | 40 |
| α Crux ..... | 23 | 5 | 22 | 46 | 22 | 28 | 22 | 10 | 21 | 52 | 21 | 34 | 21 | 12 | 20 | 54 | 20 | 36 | 20 | 17 | 19 | 59 | 19 | 40 |
| FOMALHAUT | 23 | 56 | 23 | 37 | 23 | 19 | 23 | 1 | 22 | 43 | 22 | 25 | 22 | 8 | 21 | 46 | 21 | 27 | 21 | 8 | 20 | 50 | 20 | 31 |
| *Scheat* .... | 0 | 7 | 23 | 44 | 23 | 26 | 23 | 8 | 22 | 50 | 22 | 32 | 22 | 10 | 21 | 52 | 21 | 34 | 21 | 15 | 20 | 57 | 20 | 38 |
| MARCAB... | 0 | 8 | 23 | 45 | 23 | 27 | 23 | 8 | 22 | 51 | 22 | 33 | 22 | 10 | 21 | 53 | 21 | 35 | 21 | 16 | 20 | 58 | 20 | 39 |
| *Alpheratz*.. | 1 | 11 | 0 | 52 | 0 | 34 | 0 | 16 | 23 | 53 | 23 | 35 | 23 | 13 | 22 | 56 | 22 | 38 | 22 | 20 | 22 | 1 | 21 | 42 |

# TABLE XLIV.

## For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

| | May. | | | | | | | | | | | | June. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | |
| | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. |
| *Algenib* ... | 21 | 28 | 21 | 9 | 20 | 50 | 20 | 30 | 20 | 10 | 19 | 50 | 19 | 26 | 19 | 5 | 18 | 44 | 18 | 24 | 18 | 3 | 17 | 42 |
| *Schedar* ... | 21 | 54 | 21 | 34 | 21 | 16 | 20 | 56 | 20 | 36 | 20 | 16 | 19 | 52 | 19 | 31 | 19 | 11 | 18 | 50 | 18 | 29 | 18 | 8 |
| *Polar Star*. | 22 | 20 | 22 | 1 | 21 | 42 | 21 | 22 | 21 | 2 | 20 | 43 | 20 | 19 | 19 | 58 | 19 | 37 | 19 | 17 | 18 | 56 | 18 | 35 |
| *Mirach*.... | 22 | 23 | 22 | 4 | 21 | 44 | 21 | 25 | 21 | 5 | 20 | 46 | 20 | 20 | 20 | 1 | 19 | 40 | 19 | 19 | 18 | 58 | 18 | 38 |
| *Achernar* .. | 22 | 54 | 22 | 35 | 22 | 16 | 21 | 56 | 21 | 36 | 21 | 16 | 20 | 52 | 20 | 31 | 20 | 11 | 19 | 51 | 19 | 30 | 19 | 9 |
| α Arietis ... | 23 | 20 | 23 | 1 | 22 | 42 | 22 | 22 | 22 | 2 | 21 | 42 | 21 | 18 | 20 | 57 | 20 | 36 | 20 | 17 | 19 | 56 | 19 | 35 |
| *Menkar* ... | 0 | 20 | 0 | 1 | 23 | 37 | 23 | 18 | 22 | 58 | 22 | 38 | 22 | 13 | 21 | 53 | 21 | 32 | 21 | 11 | 20 | 51 | 20 | 30 |
| *Algol* ..... | 0 | 24 | 0 | 4 | 23 | 41 | 23 | 21 | 23 | 2 | 22 | 41 | 22 | 17 | 21 | 56 | 21 | 36 | 21 | 15 | 20 | 54 | 20 | 33 |
| α Perseus... | 0 | 39 | 0 | 20 | 23 | 56 | 23 | 36 | 23 | 17 | 22 | 56 | 22 | 32 | 22 | 12 | 21 | 51 | 21 | 30 | 21 | 9 | 20 | 49 |
| ALDEBARAN | 1 | 53 | 1 | 34 | 1 | 14 | 0 | 55 | 0 | 35 | 0 | 15 | 23 | 46 | 23 | 26 | 23 | 5 | 22 | 44 | 22 | 23 | 22 | 3 |
| *Capella*.... | 2 | 31 | 2 | 11 | 1 | 52 | 1 | 32 | 1 | 12 | 0 | 52 | 0 | 28 | 0 | 7 | 23 | 43 | 23 | 22 | 23 | 1 | 22 | 40 |
| *Rigel* ..... | 2 | 33 | 2 | 14 | 1 | 54 | 1 | 35 | 1 | 15 | 0 | 55 | 0 | 30 | 0 | 10 | 23 | 45 | 23 | 24 | 23 | 4 | 22 | 43 |
| β Taurus.... | 2 | 42 | 2 | 23 | 2 | 4 | 1 | 44 | 1 | 24 | 1 | 4 | 0 | 39 | 0 | 19 | 23 | 54 | 23 | 33 | 23 | 13 | 22 | 52 |
| *Bellatrix* .. | 2 | 43 | 2 | 23 | 2 | 4 | 1 | 44 | 1 | 25 | 1 | 4 | 0 | 40 | 0 | 19 | 23 | 55 | 23 | 34 | 23 | 13 | 22 | 52 |
| δ Orion..... | 2 | 50 | 2 | 31 | 2 | 11 | 1 | 52 | 1 | 32 | 1 | 12 | 0 | 47 | 0 | 27 | 0 | 6 | 23 | 41 | 23 | 21 | 23 | 0 |
| ε Orion..... | 2 | 54 | 2 | 35 | 2 | 16 | 1 | 56 | 1 | 36 | 1 | 16 | 0 | 52 | 0 | 31 | 0 | 10 | 23 | 46 | 23 | 25 | 23 | 4 |
| α Columba .. | 3 | 0 | 2 | 41 | 2 | 22 | 2 | 2 | 1 | 42 | 1 | 22 | 0 | 58 | 0 | 37 | 0 | 16 | 23 | 52 | 23 | 31 | 23 | 10 |
| *Betelguese* . | 3 | 11 | 2 | 53 | 2 | 34 | 2 | 14 | 1 | 54 | 1 | 34 | 1 | 10 | 0 | 49 | 0 | 29 | 0 | 8 | 23 | 43 | 23 | 22 |
| *Canopus*... | 3 | 46 | 3 | 27 | 3 | 9 | 2 | 49 | 2 | 29 | 2 | 9 | 1 | 44 | 1 | 24 | 1 | 3 | 0 | 43 | 0 | 22 | 0 | 1 |
| *Sirius*..... | 4 | 3 | 3 | 44 | 3 | 25 | 3 | 6 | 2 | 46 | 2 | 26 | 2 | 2 | 1 | 41 | 1 | 21 | 1 | 0 | 0 | 39 | 0 | 18 |
| *Castor* .... | 4 | 49 | 4 | 30 | 4 | 11 | 3 | 51 | 3 | 31 | 3 | 11 | 2 | 48 | 2 | 27 | 2 | 6 | 1 | 46 | 1 | 25 | 1 | 4 |
| *Procyon* ... | 4 | 56 | 4 | 37 | 4 | 17 | 3 | 58 | 3 | 38 | 3 | 18 | 2 | 54 | 2 | 34 | 2 | 13 | 1 | 52 | 1 | 32 | 1 | 11 |
| POLLUX .... | 5 | 0 | 4 | 41 | 4 | 22 | 4 | 2 | 3 | 42 | 3 | 22 | 2 | 59 | 2 | 38 | 2 | 18 | 1 | 57 | 1 | 36 | 1 | 15 |
| ξ Argo Navis | 5 | 23 | 5 | 4 | 4 | 45 | 4 | 25 | 4 | 5 | 3 | 45 | 3 | 21 | 3 | 0 | 2 | 41 | 2 | 20 | 1 | 59 | 1 | 38 |
| γ Argo Navis | 5 | 30 | 5 | 11 | 4 | 52 | 4 | 32 | 4 | 12 | 3 | 52 | 3 | 28 | 3 | 7 | 2 | 47 | 2 | 27 | 2 | 6 | 1 | 45 |
| ι Argo Navis | 6 | 6 | 5 | 47 | 5 | 27 | 5 | 8 | 4 | 48 | 4 | 28 | 4 | 3 | 3 | 43 | 3 | 22 | 3 | 1 | 2 | 42 | 2 | 21 |
| β Argo Navis | 6 | 37 | 6 | 18 | 5 | 59 | 5 | 39 | 5 | 19 | 4 | 59 | 4 | 35 | 4 | 14 | 3 | 54 | 3 | 33 | 3 | 12 | 2 | 51 |
| *Alphard* ... | 6 | 45 | 6 | 26 | 6 | 6 | 5 | 47 | 5 | 27 | 5 | 7 | 4 | 42 | 4 | 22 | 4 | 1 | 3 | 40 | 3 | 20 | 2 | 59 |
| REGULUS .. | 7 | 25 | 7 | 6 | 6 | 46 | 6 | 27 | 6 | 7 | 5 | 47 | 5 | 22 | 5 | 2 | 4 | 41 | 4 | 20 | 4 | 0 | 3 | 39 |
| β Ursa Major | 8 | 17 | 7 | 58 | 7 | 38 | 7 | 19 | 6 | 59 | 6 | 39 | 6 | 14 | 5 | 54 | 5 | 33 | 5 | 12 | 4 | 52 | 4 | 31 |
| *Dubhe* .... | 8 | 19 | 8 | 0 | 7 | 40 | 7 | 20 | 7 | 1 | 6 | 40 | 6 | 16 | 5 | 56 | 5 | 35 | 5 | 14 | 4 | 53 | 4 | 33 |
| *Deneb*..... | 9 | 6 | 8 | 47 | 8 | 27 | 8 | 8 | 7 | 48 | 7 | 28 | 7 | 3 | 6 | 43 | 6 | 22 | 6 | 1 | 5 | 41 | 5 | 20 |
| γ Ursa Major | 9 | 10 | 8 | 51 | 8 | 32 | 8 | 12 | 7 | 52 | 7 | 32 | 7 | 8 | 6 | 47 | 6 | 27 | 6 | 6 | 5 | 45 | 5 | 24 |
| α Crux ..... | 9 | 42 | 9 | 23 | 9 | 4 | 8 | 45 | 8 | 25 | 8 | 5 | 7 | 40 | 7 | 20 | 6 | 59 | 6 | 38 | 6 | 17 | 5 | 57 |
| γ Crux ..... | 9 | 46 | 9 | 27 | 9 | 9 | 8 | 49 | 8 | 29 | 8 | 9 | 7 | 45 | 7 | 24 | 7 | 4 | 6 | 43 | 6 | 22 | 6 | 1 |
| SPICA..... | 10 | 41 | 10 | 22 | 10 | 2 | 9 | 43 | 9 | 23 | 9 | 3 | 8 | 39 | 8 | 18 | 7 | 58 | 7 | 37 | 7 | 17 | 6 | 56 |
| *Benetnach* . | 11 | 6 | 10 | 46 | 10 | 27 | 10 | 8 | 9 | 47 | 9 | 27 | 9 | 3 | 8 | 43 | 8 | 23 | 8 | 2 | 7 | 41 | 7 | 20 |
| β Centaur... | 11 | 16 | 10 | 57 | 10 | 38 | 10 | 18 | 9 | 58 | 9 | 38 | 9 | 14 | 8 | 55 | 8 | 34 | 8 | 13 | 7 | 52 | 7 | 31 |
| α Draco..... | 11 | 25 | 11 | 6 | 10 | 46 | 10 | 26 | 10 | 7 | 9 | 46 | 9 | 22 | 9 | 2 | 8 | 41 | 8 | 21 | 8 | 0 | 7 | 40 |
| *Arcturus* .. | 11 | 33 | 11 | 13 | 10 | 54 | 10 | 34 | 10 | 14 | 9 | 54 | 9 | 30 | 9 | 10 | 8 | 49 | 8 | 29 | 8 | 8 | 7 | 47 |
| *Seginus* ... | 11 | 50 | 11 | 31 | 11 | 11 | 10 | 52 | 10 | 32 | 10 | 12 | 9 | 47 | 9 | 27 | 9 | 6 | 8 | 46 | 8 | 26 | 8 | 5 |
| α Centaur... | 11 | 53 | 11 | 34 | 11 | 15 | 10 | 55 | 10 | 35 | 10 | 15 | 9 | 51 | 9 | 30 | 9 | 9 | 8 | 49 | 8 | 29 | 8 | 8 |
| *Zubenesch* . | 12 | 6 | 11 | 47 | 11 | 27 | 11 | 3 | 10 | 48 | 10 | 28 | 10 | 3 | 9 | 43 | 9 | 22 | 9 | 1 | 8 | 42 | 8 | 21 |
| *Zubenelg* .. | 12 | 33 | 12 | 13 | 11 | 54 | 11 | 34 | 11 | 14 | 10 | 54 | 10 | 30 | 10 | 9 | 9 | 49 | 9 | 28 | 9 | 7 | 8 | 46 |
| *Alphacca* .. | 12 | 52 | 12 | 33 | 12 | 14 | 11 | 54 | 11 | 34 | 11 | 14 | 10 | 50 | 10 | 29 | 10 | 8 | 9 | 48 | 9 | 27 | 9 | 6 |
| α Serpens ... | 13 | 1 | 12 | 41 | 12 | 22 | 12 | 2 | 11 | 42 | 11 | 22 | 10 | 58 | 10 | 37 | 10 | 17 | 9 | 56 | 9 | 35 | 9 | 14 |
| ANTARES .. | 13 | 44 | 13 | 24 | 13 | 5 | 12 | 45 | 12 | 25 | 12 | 5 | 11 | 41 | 11 | 20 | 11 | 0 | 10 | 39 | 10 | 18 | 9 | 57 |
| *Ras Algethi* | 14 | 32 | 14 | 12 | 13 | 53 | 13 | 33 | 13 | 13 | 12 | 53 | 12 | 29 | 12 | 8 | 11 | 48 | 11 | 27 | 11 | 6 | 10 | 45 |
| *Ras Alhague* | 14 | 52 | 14 | 33 | 14 | 13 | 13 | 54 | 13 | 34 | 13 | 14 | 12 | 49 | 12 | 29 | 12 | 8 | 11 | 47 | 11 | 26 | 11 | 6 |
| *Rastaban*.. | 15 | 18 | 14 | 58 | 14 | 39 | 14 | 19 | 13 | 59 | 13 | 39 | 13 | 15 | 12 | 54 | 12 | 34 | 12 | 13 | 11 | 52 | 11 | 31 |
| *Vega* ..... | 15 | 55 | 15 | 36 | 15 | 17 | 14 | 58 | 14 | 38 | 14 | 18 | 13 | 53 | 13 | 33 | 13 | 12 | 12 | 51 | 12 | 31 | 12 | 10 |
| α AQUILÆ ... | 17 | 6 | 16 | 47 | 16 | 28 | 16 | 8 | 15 | 48 | 15 | 28 | 15 | 4 | 14 | 43 | 14 | 23 | 14 | 3 | 13 | 42 | 13 | 21 |
| α Pavo ..... | 17 | 36 | 17 | 16 | 16 | 57 | 16 | 37 | 16 | 17 | 15 | 57 | 15 | 33 | 15 | 12 | 14 | 52 | 14 | 31 | 14 | 11 | 13 | 50 |
| *Deneb*..... | 17 | 59 | 17 | 40 | 17 | 21 | 17 | 1 | 16 | 41 | 16 | 21 | 15 | 57 | 15 | 36 | 15 | 16 | 14 | 55 | 14 | 34 | 14 | 14 |
| *Alderaimin*. | 18 | 38 | 18 | 19 | 18 | 0 | 17 | 40 | 17 | 20 | 17 | 0 | 16 | 36 | 16 | 15 | 15 | 55 | 15 | 34 | 15 | 13 | 14 | 52 |
| α Aquarius.. | 19 | 21 | 19 | 2 | 18 | 42 | 18 | 22 | 18 | 3 | 17 | 42 | 17 | 18 | 16 | 58 | 16 | 37 | 16 | 16 | 15 | 55 | 15 | 35 |
| α Grux ..... | 19 | 21 | 19 | 2 | 18 | 42 | 18 | 23 | 18 | 3 | 17 | 43 | 17 | 18 | 16 | 58 | 16 | 37 | 16 | 16 | 15 | 56 | 15 | 35 |
| FOMALHAUT | 20 | 12 | 19 | 53 | 19 | 33 | 19 | 14 | 18 | 54 | 18 | 34 | 18 | 9 | 17 | 49 | 17 | 28 | 17 | 7 | 16 | 46 | 16 | 26 |
| *Scheat* .... | 20 | 19 | 20 | 0 | 19 | 41 | 19 | 21 | 19 | 1 | 18 | 41 | 18 | 17 | 17 | 56 | 17 | 35 | 17 | 15 | 16 | 54 | 16 | 33 |
| MARCAB... | 20 | 20 | 20 | 1 | 19 | 41 | 19 | 22 | 19 | 2 | 18 | 42 | 18 | 17 | 17 | 57 | 17 | 36 | 17 | 15 | 16 | 55 | 16 | 34 |
| *Alpheratz*.. | 21 | 23 | 21 | 4 | 20 | 45 | 20 | 25 | 20 | 5 | 19 | 45 | 19 | 21 | 19 | 0 | 18 | 39 | 18 | 19 | 17 | 58 | 17 | 37 |

# TABLE XLIV.

## For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

| | July. | | | | | | | | | | | | August. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | |
| | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. |
| *Algenib* ... | 17 | 21 | 17 | 1 | 16 | 40 | 16 | 20 | 16 | 0 | 15 | 40 | 15 | 17 | 14 | 58 | 14 | 39 | 14 | 20 | 14 | 2 | 13 | 43 |
| *Schedar* ... | 17 | 48 | 17 | 27 | 17 | 6 | 16 | 46 | 16 | 26 | 16 | 6 | 15 | 43 | 15 | 24 | 15 | 5 | 14 | 47 | 14 | 28 | 14 | 9 |
| *Polar Star* | 18 | 14 | 17 | 54 | 17 | 33 | 17 | 13 | 16 | 53 | 16 | 33 | 16 | 9 | 15 | 50 | 15 | 32 | 15 | 13 | 14 | 55 | 14 | 36 |
| *Mirach*.... | 18 | 17 | 17 | 56 | 17 | 36 | 17 | 15 | 16 | 55 | 16 | 36 | 16 | 12 | 15 | 53 | 15 | 35 | 15 | 16 | 14 | 57 | 14 | 39 |
| *Achernar* .. | 18 | 48 | 18 | 28 | 18 | 7 | 17 | 47 | 17 | 27 | 17 | 7 | 16 | 43 | 16 | 24 | 16 | 6 | 15 | 47 | 15 | 29 | 15 | 10 |
| α ARIETIS ... | 19 | 14 | 18 | 54 | 18 | 33 | 18 | 13 | 17 | 53 | 17 | 33 | 17 | 9 | 16 | 50 | 16 | 31 | 16 | 12 | 15 | 55 | 15 | 36 |
| *Menkar* ... | 20 | 10 | 19 | 50 | 19 | 29 | 19 | 9 | 18 | 49 | 18 | 29 | 18 | 5 | 17 | 46 | 17 | 27 | 17 | 8 | 16 | 49 | 16 | 31 |
| *Algol* ..... | 20 | 14 | 19 | 53 | 19 | 33 | 19 | 12 | 18 | 52 | 18 | 33 | 18 | 9 | 17 | 50 | 17 | 30 | 17 | 12 | 16 | 53 | 16 | 35 |
| α Perseus... | 20 | 29 | 20 | 8 | 19 | 48 | 19 | 27 | 19 | 7 | 18 | 47 | 18 | 24 | 18 | 5 | 17 | 46 | 17 | 27 | 17 | 8 | 16 | 50 |
| ALDEBARAN | 21 | 42 | 21 | 21 | 21 | 1 | 20 | 41 | 20 | 21 | 20 | 1 | 19 | 38 | 19 | 19 | 19 | 0 | 18 | 41 | 18 | 22 | 18 | 4 |
| *Capella*.... | 22 | 20 | 21 | 59 | 21 | 39 | 21 | 18 | 20 | 59 | 20 | 39 | 20 | 16 | 19 | 56 | 19 | 37 | 19 | 19 | 19 | 0 | 18 | 42 |
| *Rigel* ..... | 22 | 22 | 22 | 2 | 21 | 41 | 21 | 21 | 21 | 2 | 20 | 42 | 20 | 18 | 19 | 59 | 19 | 40 | 19 | 21 | 19 | 2 | 18 | 44 |
| β Taurus.... | 22 | 31 | 22 | 11 | 21 | 50 | 21 | 30 | 21 | 10 | 20 | 51 | 20 | 27 | 20 | 8 | 19 | 49 | 19 | 30 | 19 | 11 | 18 | 53 |
| *Bellatrix* .. | 22 | 32 | 22 | 11 | 21 | 51 | 21 | 30 | 21 | 10 | 20 | 51 | 20 | 28 | 20 | 9 | 19 | 49 | 19 | 31 | 19 | 12 | 18 | 54 |
| ϑ Orion..... | 22 | 39 | 22 | 18 | 21 | 58 | 21 | 38 | 21 | 18 | 20 | 58 | 20 | 35 | 20 | 16 | 19 | 57 | 19 | 38 | 19 | 19 | 19 | 1 |
| ι Orion ..... | 22 | 43 | 22 | 23 | 22 | 2 | 21 | 42 | 21 | 22 | 21 | 2 | 20 | 39 | 20 | 20 | 20 | 1 | 19 | 42 | 19 | 24 | 19 | 5 |
| α Columba .. | 22 | 49 | 22 | 29 | 22 | 8 | 21 | 48 | 21 | 28 | 21 | 8 | 20 | 46 | 20 | 26 | 20 | 7 | 19 | 48 | 19 | 30 | 19 | 11 |
| *Beteiguese* . | 23 | 2 | 22 | 41 | 22 | 21 | 22 | 0 | 21 | 40 | 21 | 20 | 20 | 58 | 20 | 39 | 20 | 19 | 20 | 1 | 19 | 42 | 19 | 24 |
| *Canopus* ... | 23 | 36 | 23 | 16 | 22 | 55 | 22 | 35 | 22 | 15 | 21 | 55 | 21 | 32 | 21 | 13 | 20 | 54 | 20 | 35 | 20 | 17 | 19 | 58 |
| *Sirius*..... | 23 | 53 | 23 | 33 | 23 | 12 | 22 | 52 | 22 | 32 | 22 | 12 | 21 | 50 | 21 | 30 | 21 | 11 | 20 | 52 | 20 | 34 | 20 | 15 |
| *Castor* .... | 0 | 43 | 0 | 23 | 0 | 2 | 23 | 38 | 23 | 18 | 22 | 58 | 22 | 34 | 22 | 15 | 21 | 56 | 21 | 38 | 21 | 20 | 21 | 1 |
| *Procyon* ... | 0 | 50 | 0 | 30 | 0 | 9 | 23 | 45 | 23 | 25 | 23 | 5 | 22 | 41 | 22 | 22 | 22 | 3 | 21 | 45 | 21 | 26 | 21 | 8 |
| POLLUX .... | 0 | 55 | 0 | 34 | 0 | 13 | 23 | 49 | 23 | 29 | 23 | 9 | 22 | 46 | 22 | 26 | 22 | 7 | 21 | 50 | 21 | 31 | 21 | 12 |
| ξ Argo Navis | 1 | 18 | 0 | 57 | 0 | 36 | 0 | 16 | 23 | 52 | 23 | 32 | 23 | 9 | 22 | 49 | 22 | 30 | 22 | 12 | 21 | 54 | 21 | 35 |
| γ Argo Navis | 1 | 24 | 1 | 4 | 0 | 43 | 0 | 23 | 0 | 3 | 23 | 39 | 23 | 15 | 22 | 56 | 22 | 37 | 22 | 19 | 22 | 1 | 21 | 42 |
| ι Argo Navis | 2 | 0 | 1 | 39 | 1 | 19 | 0 | 59 | 0 | 38 | 0 | 19 | 23 | 51 | 23 | 32 | 23 | 13 | 22 | 54 | 22 | 36 | 22 | 18 |
| β Argo Navis | 2 | 31 | 2 | 11 | 1 | 50 | 1 | 30 | 1 | 10 | 0 | 50 | 0 | 27 | 0 | 7 | 23 | 44 | 23 | 25 | 23 | 7 | 22 | 49 |
| *Alphard* ... | 2 | 39 | 2 | 18 | 1 | 58 | 1 | 38 | 1 | 18 | 0 | 58 | 0 | 34 | 0 | 15 | 23 | 52 | 23 | 33 | 23 | 14 | 22 | 56 |
| REGULUS .. | 3 | 18 | 2 | 58 | 2 | 38 | 2 | 18 | 1 | 58 | 1 | 38 | 1 | 14 | 0 | 55 | 0 | 36 | 0 | 17 | 23 | 54 | 23 | 36 |
| β Ursa Major | 4 | 10 | 3 | 50 | 3 | 29 | 3 | 10 | 2 | 50 | 2 | 30 | 2 | 6 | 1 | 47 | 1 | 28 | 1 | 9 | 0 | 51 | 0 | 32 |
| *Dubhe* .... | 4 | 12 | 3 | 51 | 3 | 31 | 3 | 11 | 2 | 51 | 2 | 31 | 2 | 8 | 1 | 49 | 1 | 30 | 1 | 11 | 0 | 52 | 0 | 34 |
| *Deneb*..... | 4 | 59 | 4 | 39 | 4 | 18 | 3 | 58 | 3 | 38 | 3 | 18 | 2 | 55 | 2 | 36 | 2 | 17 | 1 | 58 | 1 | 39 | 1 | 21 |
| γ Ursa Major | 5 | 4 | 4 | 43 | 4 | 22 | 4 | 2 | 3 | 42 | 3 | 22 | 3 | 0 | 2 | 40 | 2 | 21 | 2 | 3 | 1 | 44 | 1 | 26 |
| α Crux ..... | 5 | 36 | 5 | 15 | 4 | 55 | 4 | 35 | 4 | 14 | 3 | 55 | 3 | 31 | 3 | 12 | 2 | 54 | 2 | 35 | 2 | 17 | 1 | 58 |
| γ Crux ..... | 5 | 40 | 5 | 20 | 4 | 59 | 4 | 39 | 4 | 19 | 3 | 59 | 3 | 36 | 3 | 16 | 2 | 58 | 2 | 39 | 2 | 21 | 2 | 2 |
| SPICA..... | 6 | 35 | 6 | 14 | 5 | 54 | 5 | 34 | 5 | 13 | 4 | 54 | 4 | 30 | 4 | 11 | 3 | 52 | 3 | 33 | 3 | 15 | 2 | 57 |
| *Benetnach* . | 7 | 0 | 6 | 39 | 6 | 19 | 5 | 58 | 5 | 38 | 5 | 18 | 4 | 55 | 4 | 36 | 4 | 16 | 3 | 58 | 3 | 39 | 3 | 22 |
| β Centaur ... | 7 | 10 | 6 | 50 | 6 | 29 | 6 | 9 | 5 | 49 | 5 | 29 | 5 | 6 | 4 | 46 | 4 | 27 | 4 | 8 | 3 | 50 | 3 | 31 |
| α Draco..... | 7 | 19 | 6 | 58 | 6 | 38 | 6 | 17 | 5 | 57 | 5 | 37 | 5 | 14 | 4 | 55 | 4 | 36 | 4 | 17 | 3 | 58 | 3 | 40 |
| *Arcturus* .. | 7 | 27 | 7 | 6 | 6 | 46 | 6 | 25 | 6 | 5 | 5 | 45 | 5 | 22 | 5 | 3 | 4 | 43 | 4 | 25 | 4 | 6 | 3 | 48 |
| *Seginus* ... | 7 | 44 | 7 | 23 | 7 | 3 | 6 | 43 | 6 | 23 | 6 | 3 | 5 | 39 | 5 | 20 | 5 | 1 | 4 | 42 | 4 | 23 | 4 | 5 |
| α Centaur... | 7 | 47 | 7 | 27 | 7 | 6 | 6 | 46 | 6 | 26 | 6 | 6 | 5 | 42 | 5 | 23 | 5 | 4 | 4 | 45 | 4 | 27 | 4 | 8 |
| *Zubenesch* . | 8 | 0 | 7 | 39 | 7 | 19 | 6 | 59 | 6 | 39 | 6 | 19 | 5 | 55 | 5 | 36 | 5 | 17 | 4 | 58 | 4 | 39 | 4 | 21 |
| *Zubenelg* .. | 8 | 27 | 8 | 6 | 7 | 45 | 7 | 25 | 7 | 5 | 6 | 45 | 6 | 22 | 6 | 2 | 5 | 43 | 5 | 25 | 5 | 6 | 4 | 47 |
| *Alphacca* .. | 8 | 46 | 8 | 26 | 8 | 5 | 7 | 45 | 7 | 25 | 7 | 5 | 6 | 41 | 6 | 22 | 6 | 3 | 5 | 44 | 5 | 26 | 5 | 7 |
| α Serpens ... | 8 | 55 | 8 | 34 | 8 | 14 | 7 | 53 | 7 | 33 | 7 | 13 | 6 | 50 | 6 | 30 | 6 | 11 | 5 | 53 | 5 | 34 | 5 | 16 |
| ANTARES .. | 9 | 37 | 9 | 16 | 8 | 57 | 8 | 36 | 8 | 16 | 7 | 56 | 7 | 33 | 7 | 13 | 6 | 54 | 6 | 36 | 6 | 17 | 5 | 59 |
| *Ras Algethi* | 10 | 25 | 10 | 5 | 9 | 44 | 9 | 23 | 9 | 4 | 8 | 44 | 8 | 21 | 8 | 2 | 7 | 42 | 7 | 24 | 7 | 5 | 6 | 47 |
| *Ras Alhague* | 10 | 45 | 10 | 24 | 10 | 4 | 9 | 43 | 9 | 23 | 9 | 3 | 8 | 41 | 8 | 22 | 8 | 3 | 7 | 44 | 7 | 25 | 7 | 7 |
| *Rastaban* .. | 11 | 11 | 10 | 50 | 10 | 30 | 10 | 9 | 9 | 49 | 9 | 29 | 9 | 7 | 8 | 48 | 8 | 28 | 8 | 10 | 7 | 51 | 7 | 33 |
| *Vega* ..... | 11 | 49 | 11 | 28 | 11 | 8 | 10 | 48 | 10 | 28 | 10 | 8 | 9 | 44 | 9 | 26 | 9 | 7 | 8 | 48 | 8 | 29 | 8 | 11 |
| α AQUILÆ ... | 13 | 0 | 12 | 40 | 12 | 19 | 11 | 59 | 11 | 39 | 11 | 19 | 10 | 55 | 10 | 36 | 10 | 17 | 9 | 59 | 9 | 41 | 9 | 22 |
| α Pavo ..... | 13 | 30 | 13 | 9 | 12 | 48 | 12 | 28 | 12 | 8 | 11 | 48 | 11 | 25 | 11 | 5 | 10 | 46 | 10 | 28 | 10 | 9 | 9 | 51 |
| *Deneb*..... | 13 | 54 | 13 | 33 | 13 | 12 | 12 | 52 | 12 | 32 | 12 | 12 | 11 | 49 | 11 | 29 | 11 | 10 | 10 | 51 | 10 | 33 | 10 | 14 |
| *Alderaimin*. | 14 | 33 | 14 | 12 | 13 | 51 | 13 | 31 | 13 | 11 | 12 | 51 | 12 | 28 | 12 | 8 | 11 | 49 | 11 | 30 | 11 | 12 | 10 | 53 |
| α Aquarius.. | 15 | 14 | 14 | 53 | 14 | 34 | 14 | 13 | 13 | 53 | 13 | 33 | 13 | 10 | 12 | 51 | 12 | 32 | 12 | 13 | 11 | 54 | 11 | 36 |
| α Grux ..... | 15 | 14 | 14 | 53 | 14 | 34 | 14 | 14 | 13 | 54 | 13 | 34 | 13 | 10 | 12 | 51 | 12 | 32 | 12 | 13 | 11 | 54 | 11 | 36 |
| FOMALHAUT | 16 | 5 | 15 | 44 | 15 | 24 | 15 | 5 | 14 | 44 | 14 | 25 | 14 | 1 | 13 | 42 | 13 | 23 | 13 | 4 | 12 | 45 | 12 | 27 |
| *Scheat* .... | 16 | 12 | 15 | 52 | 15 | 31 | 15 | 11 | 14 | 52 | 14 | 32 | 14 | 8 | 13 | 49 | 13 | 30 | 13 | 11 | 12 | 53 | 12 | 34 |
| MARCAB... | 16 | 13 | 15 | 52 | 15 | 32 | 15 | 12 | 14 | 53 | 14 | 33 | 14 | 9 | 13 | 50 | 13 | 31 | 13 | 12 | 12 | 53 | 12 | 35 |
| *Alpheratz*.. | 17 | 16 | 16 | 56 | 16 | 35 | 16 | 15 | 15 | 55 | 15 | 35 | 15 | 12 | 14 | 53 | 14 | 34 | 14 | 15 | 13 | 57 | 13 | 38 |

# TABLE XLIV.

## For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

| | September. | | | | | | | | October. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | |
| | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. |
| *Algenib* ... | 13 | 21 | 13 | 3 | 12 | 45 | 12 | 27 | 12 | 9 | 11 | 51 | 11 | 33 | 11 | 15 | 10 | 57 | 10 | 38 | 10 | 19 | 10 | 0 |
| *Schedar* ... | 13 | 48 | 13 | 30 | 13 | 10 | 12 | 54 | 12 | 36 | 12 | 18 | 12 | 0 | 11 | 41 | 11 | 23 | 11 | 4 | 10 | 46 | 10 | 27 |
| *Polar Star.* | 14 | 14 | 13 | 56 | 13 | 37 | 13 | 20 | 13 | 2 | 12 | 44 | 12 | 26 | 12 | 8 | 11 | 50 | 11 | 31 | 11 | 12 | 10 | 53 |
| *Mirach*.... | 14 | 17 | 14 | 0 | 13 | 40 | 13 | 23 | 13 | 5 | 12 | 47 | 12 | 29 | 12 | 11 | 11 | 52 | 11 | 34 | 11 | 15 | 10 | 56 |
| *Achernar* .. | 14 | 48 | 14 | 30 | 14 | 12 | 13 | 54 | 13 | 36 | 13 | 18 | 13 | 0 | 12 | 42 | 12 | 24 | 12 | 5 | 11 | 46 | 11 | 27 |
| α ARIETIS... | 15 | 14 | 14 | 56 | 14 | 38 | 14 | 20 | 14 | 2 | 13 | 44 | 13 | 26 | 13 | 8 | 12 | 50 | 12 | 31 | 12 | 12 | 11 | 53 |
| *Menkar* ... | 16 | 10 | 15 | 52 | 15 | 34 | 15 | 16 | 14 | 58 | 14 | 40 | 14 | 22 | 14 | 4 | 13 | 46 | 13 | 27 | 13 | 8 | 12 | 49 |
| *Algol* ..... | 16 | 14 | 15 | 56 | 15 | 38 | 15 | 20 | 15 | 2 | 14 | 44 | 14 | 26 | 14 | 7 | 13 | 49 | 13 | 31 | 13 | 12 | 12 | 53 |
| α Perseus... | 16 | 29 | 16 | 11 | 15 | 53 | 15 | 35 | 15 | 17 | 14 | 59 | 14 | 41 | 14 | 23 | 14 | 4 | 13 | 46 | 13 | 27 | 13 | 8 |
| ALDEBARAN | 17 | 42 | 17 | 24 | 17 | 6 | 16 | 49 | 16 | 31 | 16 | 13 | 15 | 55 | 15 | 37 | 15 | 18 | 15 | 0 | 14 | 41 | 14 | 22 |
| *Capella*.... | 18 | 20 | 18 | 2 | 17 | 44 | 17 | 26 | 17 | 9 | 16 | 50 | 16 | 33 | 16 | 14 | 15 | 56 | 15 | 38 | 15 | 19 | 15 | 0 |
| *Rigel* ..... | 18 | 22 | 18 | 4 | 17 | 46 | 17 | 28 | 17 | 10 | 16 | 52 | 16 | 35 | 16 | 17 | 16 | 0 | 15 | 40 | 15 | 21 | 15 | 2 |
| β Taurus.... | 18 | 31 | 18 | 13 | 17 | 55 | 17 | 37 | 17 | 19 | 17 | 1 | 16 | 44 | 16 | 26 | 16 | 8 | 15 | 49 | 15 | 30 | 15 | 11 |
| *Bellatrix* .. | 18 | 32 | 18 | 14 | 17 | 56 | 17 | 38 | 17 | 20 | 17 | 2 | 16 | 45 | 16 | 26 | 16 | 8 | 15 | 50 | 15 | 31 | 15 | 12 |
| ϑ Orion..... | 18 | 39 | 18 | 21 | 18 | 3 | 17 | 45 | 17 | 27 | 17 | 9 | 16 | 51 | 16 | 34 | 16 | 15 | 15 | 57 | 15 | 38 | 15 | 19 |
| ι Orion..... | 18 | 43 | 18 | 25 | 18 | 7 | 17 | 49 | 17 | 31 | 17 | 13 | 16 | 55 | 16 | 37 | 16 | 20 | 16 | 1 | 15 | 42 | 15 | 23 |
| α Columba .. | 18 | 49 | 18 | 31 | 18 | 13 | 17 | 55 | 17 | 37 | 17 | 19 | 17 | 1 | 16 | 43 | 16 | 26 | 16 | 7 | 15 | 48 | 15 | 29 |
| *Betelguese* . | 19 | 2 | 18 | 44 | 18 | 26 | 18 | 8 | 17 | 50 | 17 | 32 | 17 | 14 | 16 | 55 | 16 | 37 | 16 | 20 | 16 | 0 | 15 | 42 |
| *Canopus* ... | 19 | 36 | 19 | 18 | 19 | 0 | 18 | 42 | 18 | 24 | 18 | 6 | 17 | 48 | 17 | 30 | 17 | 12 | 16 | 53 | 16 | 34 | 16 | 15 |
| *Sirius*..... | 19 | 53 | 19 | 35 | 19 | 17 | 18 | 59 | 18 | 41 | 18 | 23 | 18 | 5 | 17 | 47 | 17 | 29 | 17 | 10 | 16 | 52 | 16 | 32 |
| *Castor* .... | 20 | 39 | 20 | 21 | 20 | 3 | 19 | 45 | 19 | 27 | 19 | 9 | 18 | 51 | 18 | 33 | 18 | 15 | 17 | 57 | 17 | 37 | 17 | 18 |
| *Procyon* ... | 20 | 46 | 20 | 28 | 20 | 10 | 19 | 52 | 19 | 34 | 19 | 16 | 18 | 58 | 18 | 40 | 18 | 22 | 18 | 4 | 17 | 44 | 17 | 25 |
| POLLUX ... | 20 | 51 | 20 | 32 | 20 | 14 | 19 | 56 | 19 | 39 | 19 | 21 | 19 | 2 | 18 | 44 | 18 | 27 | 18 | 7 | 17 | 49 | 17 | 30 |
| ξ Argo Navis | 21 | 14 | 20 | 55 | 20 | 37 | 20 | 19 | 20 | 1 | 19 | 44 | 19 | 25 | 19 | 7 | 18 | 49 | 18 | 30 | 18 | 12 | 17 | 53 |
| γ Argo Navis | 21 | 20 | 21 | 2 | 20 | 44 | 20 | 26 | 20 | 8 | 19 | 50 | 19 | 32 | 19 | 14 | 18 | 56 | 18 | 37 | 18 | 18 | 18 | 0 |
| δ Argo Navis | 21 | 56 | 21 | 38 | 21 | 20 | 21 | 2 | 20 | 44 | 20 | 26 | 20 | 8 | 19 | 50 | 19 | 31 | 19 | 13 | 18 | 54 | 18 | 35 |
| β Argo Navis | 22 | 26 | 22 | 9 | 21 | 51 | 21 | 33 | 21 | 15 | 20 | 57 | 20 | 39 | 20 | 21 | 20 | 3 | 19 | 44 | 19 | 26 | 19 | 6 |
| *Alphard* ... | 22 | 34 | 22 | 17 | 22 | 0 | 21 | 41 | 21 | 23 | 21 | 5 | 20 | 47 | 20 | 29 | 20 | 10 | 19 | 52 | 19 | 33 | 19 | 14 |
| REGULUS .. | 23 | 14 | 22 | 57 | 22 | 39 | 22 | 21 | 22 | 3 | 21 | 45 | 21 | 27 | 21 | 9 | 20 | 50 | 20 | 32 | 20 | 13 | 19 | 54 |
| β Ursa Major | 0 | 10 | 23 | 48 | 23 | 30 | 23 | 12 | 22 | 55 | 22 | 37 | 22 | 19 | 22 | 1 | 21 | 43 | 21 | 24 | 21 | 5 | 20 | 46 |
| *Dubhe* .... | 0 | 12 | 23 | 50 | 23 | 32 | 23 | 14 | 22 | 57 | 22 | 39 | 22 | 21 | 22 | 3 | 21 | 44 | 21 | 26 | 21 | 7 | 20 | 48 |
| *Deneb*..... | 0 | 59 | 0 | 41 | 0 | 23 | 0 | 5 | 23 | 43 | 23 | 25 | 23 | 8 | 22 | 50 | 22 | 32 | 22 | 13 | 21 | 54 | 21 | 35 |
| γ Ursa Major | 1 | 4 | 0 | 45 | 0 | 27 | 0 | 10 | 23 | 48 | 23 | 30 | 23 | 12 | 22 | 54 | 22 | 36 | 22 | 17 | 22 | 0 | 21 | 40 |
| α Crux ..... | 1 | 36 | 1 | 18 | 1 | 0 | 0 | 42 | 0 | 24 | 0 | 6 | 23 | 44 | 23 | 26 | 23 | 8 | 22 | 50 | 22 | 31 | 22 | 12 |
| γ Crux ..... | 1 | 40 | 1 | 22 | 1 | 4 | 0 | 46 | 0 | 28 | 0 | 10 | 23 | 48 | 23 | 30 | 23 | 12 | 22 | 54 | 22 | 36 | 22 | 16 |
| SPICA.... | 2 | 35 | 2 | 17 | 1 | 59 | 1 | 41 | 1 | 23 | 1 | 5 | 0 | 47 | 0 | 29 | 0 | 10 | 23 | 48 | 23 | 30 | 23 | 10 |
| *Benetnach* . | 3 | 0 | 2 | 42 | 2 | 24 | 2 | 6 | 1 | 48 | 1 | 30 | 1 | 12 | 0 | 53 | 0 | 35 | 0 | 17 | 23 | 54 | 23 | 35 |
| β Centaur... | 3 | 10 | 2 | 52 | 2 | 34 | 2 | 16 | 1 | 58 | 1 | 40 | 1 | 22 | 1 | 4 | 0 | 46 | 0 | 27 | 0 | 9 | 23 | 45 |
| α Draco..... | 3 | 19 | 3 | 1 | 2 | 43 | 2 | 25 | 2 | 7 | 1 | 49 | 1 | 31 | 1 | 13 | 0 | 54 | 0 | 36 | 0 | 17 | 23 | 54 |
| *Arcturus* .. | 3 | 26 | 3 | 9 | 2 | 51 | 2 | 33 | 2 | 15 | 1 | 57 | 1 | 39 | 1 | 20 | 1 | 2 | 0 | 44 | 0 | 25 | 0 | 6 |
| *Seginus* ... | 3 | 43 | 3 | 26 | 3 | 8 | 2 | 50 | 2 | 32 | 2 | 14 | 1 | 56 | 1 | 38 | 1 | 19 | 1 | 1 | 0 | 42 | 0 | 23 |
| α Centaur... | 3 | 46 | 3 | 29 | 3 | 11 | 2 | 53 | 2 | 35 | 2 | 17 | 1 | 59 | 1 | 41 | 1 | 23 | 1 | 4 | 0 | 45 | 0 | 26 |
| *Zubenesch* . | 3 | 59 | 3 | 41 | 3 | 24 | 3 | 6 | 2 | 48 | 2 | 30 | 2 | 12 | 1 | 54 | 1 | 36 | 1 | 17 | 0 | 58 | 0 | 39 |
| *Zubenelg* .. | 4 | 26 | 4 | 7 | 3 | 49 | 3 | 32 | 3 | 15 | 2 | 57 | 2 | 39 | 2 | 20 | 2 | 2 | 1 | 43 | 1 | 25 | 1 | 6 |
| *Alphacca* .. | 4 | 45 | 4 | 27 | 4 | 9 | 3 | 51 | 3 | 34 | 3 | 16 | 2 | 58 | 2 | 40 | 2 | 22 | 2 | 3 | 1 | 44 | 1 | 25 |
| α Serpens... | 4 | 54 | 4 | 36 | 4 | 18 | 4 | 0 | 3 | 42 | 3 | 24 | 3 | 7 | 2 | 48 | 2 | 30 | 2 | 12 | 1 | 53 | 1 | 34 |
| ANTARES .. | 5 | 37 | 5 | 19 | 5 | 1 | 4 | 43 | 4 | 25 | 4 | 7 | 3 | 49 | 3 | 30 | 3 | 13 | 2 | 54 | 2 | 36 | 2 | 17 |
| *Ras Algethi* | 6 | 25 | 6 | 7 | 5 | 49 | 5 | 31 | 5 | 13 | 4 | 55 | 4 | 37 | 4 | 18 | 4 | 0 | 3 | 42 | 3 | 23 | 3 | 5 |
| *Ras Alhague* | 6 | 45 | 6 | 27 | 6 | 9 | 5 | 51 | 5 | 33 | 5 | 15 | 4 | 57 | 4 | 39 | 4 | 20 | 4 | 2 | 3 | 43 | 3 | 24 |
| *Rastaban* .. | 7 | 11 | 6 | 53 | 6 | 35 | 6 | 17 | 5 | 59 | 5 | 41 | 5 | 23 | 5 | 4 | 4 | 46 | 4 | 27 | 4 | 9 | 3 | 50 |
| *Vega* ..... | 7 | 49 | 7 | 31 | 7 | 13 | 6 | 55 | 6 | 37 | 6 | 19 | 6 | 1 | 5 | 43 | 5 | 25 | 5 | 6 | 4 | 47 | 4 | 28 |
| α AQUILÆ ... | 9 | 0 | 8 | 42 | 8 | 24 | 8 | 6 | 7 | 48 | 7 | 30 | 7 | 12 | 6 | 54 | 6 | 36 | 6 | 17 | 5 | 58 | 5 | 39 |
| α Pavo ..... | 9 | 30 | 9 | 11 | 8 | 53 | 8 | 36 | 8 | 18 | 8 | 0 | 7 | 42 | 7 | 23 | 7 | 5 | 6 | 46 | 6 | 28 | 6 | 9 |
| *Deneb*..... | 9 | 54 | 9 | 35 | 9 | 17 | 8 | 59 | 8 | 42 | 8 | 24 | 8 | 5 | 7 | 47 | 7 | 29 | 7 | 10 | 6 | 52 | 6 | 33 |
| *Alderaimin.* | 10 | 32 | 10 | 13 | 9 | 56 | 9 | 38 | 9 | 21 | 9 | 3 | 8 | 44 | 8 | 26 | 8 | 8 | 7 | 49 | 7 | 31 | 7 | 12 |
| α Aquarius.. | 11 | 14 | 10 | 56 | 10 | 38 | 10 | 20 | 10 | 3 | 9 | 45 | 9 | 27 | 9 | 9 | 8 | 50 | 8 | 32 | 8 | 13 | 7 | 54 |
| α Grux ..... | 11 | 14 | 10 | 56 | 10 | 38 | 10 | 20 | 10 | 3 | 9 | 45 | 9 | 27 | 9 | 9 | 8 | 50 | 8 | 32 | 8 | 13 | 7 | 54 |
| FOMALHAUT | 12 | 5 | 11 | 47 | 11 | 29 | 11 | 11 | 10 | 53 | 10 | 35 | 10 | 17 | 10 | 0 | 9 | 41 | 9 | 23 | 9 | 4 | 8 | 45 |
| *Scheat* .... | 12 | 12 | 11 | 54 | 11 | 36 | 11 | 18 | 11 | 0 | 10 | 42 | 10 | 24 | 10 | 6 | 9 | 50 | 9 | 30 | 9 | 11 | 8 | 52 |
| MARCAB... | 12 | 13 | 11 | 55 | 11 | 37 | 11 | 19 | 11 | 1 | 10 | 43 | 10 | 25 | 10 | 7 | 9 | 50 | 9 | 31 | 9 | 12 | 8 | 53 |

## For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

| | November. | | | | | | | | | | December. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | | 1 | | 6 | | 11 | | 16 | | 21 | | 26 | |
| | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. |
| *Algenib* ... | 9 | 37 | 9 | 17 | 8 | 57 | 8 | 38 | 8 | 17 | 7 | 56 | 7 | 34 | 7 | 12 | 6 | 50 | 6 | 28 | 6 | 6 | 5 | 44 |
| *Schedar* ... | 10 | 3 | 9 | 44 | 9 | 23 | 9 | 3 | 8 | 42 | 8 | 22 | 8 | 1 | 7 | 39 | 7 | 17 | 6 | 55 | 6 | 33 | 6 | 10 |
| *Polar Star.* | 10 | 30 | 10 | 10 | 9 | 50 | 9 | 30 | 9 | 9 | 8 | 48 | 8 | 27 | 8 | 5 | 7 | 44 | 7 | 21 | 6 | 59 | 6 | 37 |
| *Mirach*.... | 10 | 33 | 10 | 13 | 9 | 53 | 9 | 32 | 9 | 11 | 8 | 50 | 8 | 30 | 8 | 8 | 7 | 46 | 7 | 24 | 7 | 2 | 6 | 40 |
| *Achernar* .. | 11 | 4 | 10 | 44 | 10 | 24 | 10 | 4 | 9 | 43 | 9 | 22 | 9 | 0 | 8 | 38 | 8 | 18 | 7 | 55 | 7 | 33 | 7 | 11 |
| α ARIETIS... | 11 | 30 | 11 | 10 | 10 | 50 | 10 | 30 | 10 | 9 | 9 | 48 | 9 | 26 | 9 | 5 | 8 | 43 | 8 | 20 | 7 | 59 | 7 | 37 |
| *Menkar* ... | 12 | 26 | 12 | 6 | 11 | 46 | 11 | 26 | 11 | 5 | 10 | 44 | 10 | 22 | 10 | 0 | 9 | 38 | 9 | 16 | 8 | 54 | 8 | 32 |
| *Algol* ..... | 12 | 29 | 12 | 10 | 11 | 50 | 11 | 29 | 11 | 8 | 10 | 47 | 10 | 26 | 10 | 4 | 9 | 42 | 9 | 20 | 8 | 58 | 8 | 35 |
| α Persei... | 12 | 44 | 12 | 25 | 12 | 5 | 11 | 44 | 11 | 23 | 11 | 2 | 10 | 41 | 10 | 19 | 9 | 57 | 9 | 35 | 9 | 13 | 8 | 51 |
| ALDEBARAN | 14 | 0 | 13 | 39 | 13 | 19 | 12 | 58 | 12 | 37 | 12 | 16 | 11 | 55 | 11 | 33 | 11 | 11 | 10 | 49 | 10 | 27 | 10 | 5 |
| *Capella*.... | 14 | 36 | 14 | 17 | 13 | 57 | 13 | 36 | 13 | 15 | 12 | 54 | 12 | 33 | 12 | 11 | 11 | 49 | 11 | 27 | 11 | 5 | 10 | 42 |
| *Rigel* ..... | 14 | 39 | 14 | 19 | 13 | 59 | 13 | 39 | 13 | 18 | 12 | 57 | 12 | 35 | 12 | 13 | 11 | 51 | 11 | 29 | 11 | 7 | 10 | 45 |
| β Taurus.... | 14 | 48 | 14 | 28 | 14 | 8 | 13 | 48 | 13 | 27 | 13 | 6 | 12 | 44 | 12 | 22 | 12 | 0 | 11 | 38 | 11 | 16 | 10 | 54 |
| *Bellatrix* .. | 14 | 48 | 14 | 29 | 14 | 9 | 13 | 48 | 13 | 27 | 13 | 6 | 12 | 45 | 12 | 23 | 12 | 1 | 11 | 39 | 11 | 17 | 10 | 54 |
| δ Orion..... | 14 | 56 | 14 | 36 | 14 | 16 | 13 | 55 | 13 | 35 | 13 | 13 | 12 | 52 | 12 | 30 | 12 | 8 | 11 | 46 | 11 | 24 | 11 | 2 |
| ε Orion..... | 15 | 0 | 14 | 40 | 14 | 20 | 14 | 0 | 13 | 39 | 13 | 18 | 12 | 56 | 12 | 35 | 12 | 13 | 11 | 50 | 11 | 28 | 11 | 6 |
| α Columba .. | 15 | 6 | 14 | 46 | 14 | 26 | 14 | 6 | 13 | 45 | 13 | 24 | 13 | 2 | 12 | 41 | 12 | 19 | 11 | 57 | 11 | 34 | 11 | 12 |
| *Betelgueze* . | 15 | 18 | 14 | 58 | 14 | 39 | 14 | 18 | 13 | 57 | 13 | 36 | 13 | 15 | 12 | 53 | 12 | 31 | 12 | 9 | 11 | 47 | 11 | 24 |
| *Canopus*... | 15 | 52 | 15 | 33 | 15 | 12 | 14 | 53 | 14 | 31 | 14 | 11 | 13 | 49 | 13 | 27 | 13 | 4 | 12 | 44 | 12 | 21 | 11 | 59 |
| *Sirius*..... | 16 | 9 | 15 | 49 | 15 | 29 | 15 | 9 | 14 | 48 | 14 | 27 | 14 | 6 | 13 | 45 | 13 | 22 | 13 | 1 | 12 | 38 | 12 | 16 |
| *Castor* .... | 16 | 55 | 16 | 35 | 16 | 15 | 15 | 55 | 15 | 34 | 15 | 13 | 14 | 51 | 14 | 30 | 14 | 8 | 13 | 46 | 13 | 24 | 13 | 2 |
| *Procyon* ... | 17 | 2 | 16 | 42 | 16 | 22 | 16 | 2 | 15 | 41 | 15 | 20 | 14 | 58 | 14 | 36 | 14 | 14 | 13 | 52 | 13 | 30 | 13 | 9 |
| POLLUX ... | 17 | 6 | 16 | 46 | 16 | 26 | 16 | 6 | 15 | 45 | 15 | 24 | 15 | 2 | 14 | 41 | 14 | 19 | 13 | 57 | 13 | 34 | 13 | 13 |
| ξ Argo Navis | 17 | 29 | 17 | 9 | 16 | 49 | 16 | 29 | 16 | 8 | 15 | 47 | 15 | 25 | 15 | 4 | 14 | 42 | 14 | 20 | 13 | 57 | 13 | 35 |
| γ Argo Navis | 17 | 36 | 17 | 16 | 16 | 56 | 16 | 37 | 16 | 15 | 15 | 54 | 15 | 32 | 15 | 10 | 14 | 49 | 14 | 26 | 14 | 4 | 13 | 42 |
| δ Argo Navis | 18 | 12 | 17 | 52 | 17 | 32 | 17 | 11 | 16 | 51 | 16 | 29 | 16 | 8 | 15 | 46 | 15 | 24 | 15 | 2 | 14 | 40 | 14 | 18 |
| β Argo Navis | 18 | 43 | 18 | 23 | 18 | 3 | 17 | 43 | 17 | 22 | 17 | 1 | 16 | 39 | 16 | 18 | 15 | 56 | 15 | 34 | 15 | 11 | 14 | 49 |
| *Alphard* ... | 18 | 51 | 18 | 31 | 18 | 11 | 17 | 50 | 17 | 30 | 17 | 8 | 16 | 47 | 16 | 25 | 16 | 3 | 15 | 41 | 15 | 19 | 14 | 57 |
| REGULUS .. | 19 | 31 | 19 | 11 | 18 | 51 | 18 | 30 | 18 | 10 | 17 | 48 | 17 | 27 | 17 | 5 | 16 | 43 | 16 | 21 | 15 | 59 | 15 | 37 |
| β Ursa Major | 20 | 23 | 20 | 3 | 19 | 43 | 19 | 23 | 19 | 2 | 18 | 41 | 18 | 19 | 17 | 57 | 17 | 35 | 17 | 13 | 16 | 51 | 16 | 29 |
| *Dubhe* .... | 20 | 24 | 20 | 5 | 19 | 45 | 19 | 24 | 19 | 3 | 18 | 42 | 18 | 21 | 17 | 59 | 17 | 37 | 17 | 15 | 16 | 53 | 16 | 31 |
| *Deneb*..... | 21 | 12 | 20 | 52 | 20 | 32 | 20 | 11 | 19 | 51 | 19 | 30 | 19 | 8 | 18 | 46 | 18 | 24 | 18 | 2 | 17 | 40 | 17 | 18 |
| γ Ursa Major | 21 | 16 | 20 | 56 | 20 | 36 | 20 | 16 | 19 | 55 | 19 | 34 | 19 | 13 | 18 | 51 | 18 | 29 | 18 | 7 | 17 | 45 | 17 | 22 |
| α Crux ..... | 21 | 49 | 21 | 28 | 21 | 8 | 20 | 48 | 20 | 26 | 20 | 6 | 19 | 45 | 19 | 22 | 19 | 1 | 18 | 38 | 18 | 17 | 17 | 55 |
| γ Crux ..... | 21 | 53 | 21 | 34 | 21 | 12 | 20 | 53 | 20 | 31 | 20 | 10 | 19 | 49 | 19 | 27 | 19 | 6 | 18 | 43 | 18 | 21 | 17 | 59 |
| SPICA.... | 22 | 47 | 22 | 27 | 22 | 7 | 21 | 46 | 21 | 26 | 21 | 4 | 20 | 43 | 20 | 21 | 20 | 0 | 19 | 37 | 19 | 15 | 18 | 54 |
| *Benetnach* . | 23 | 12 | 22 | 52 | 22 | 32 | 22 | 11 | 21 | 50 | 21 | 29 | 21 | 8 | 20 | 46 | 20 | 24 | 20 | 2 | 19 | 40 | 19 | 17 |
| β Centaur ... | 23 | 22 | 23 | 2 | 22 | 42 | 22 | 22 | 22 | 1 | 21 | 40 | 21 | 18 | 20 | 57 | 20 | 35 | 20 | 13 | 19 | 50 | 19 | 28 |
| α Draco..... | 23 | 30 | 23 | 11 | 22 | 51 | 22 | 30 | 22 | 9 | 21 | 48 | 21 | 27 | 21 | 5 | 20 | 43 | 20 | 21 | 19 | 59 | 19 | 37 |
| *Arcturus* .. | 23 | 38 | 23 | 19 | 22 | 59 | 22 | 38 | 22 | 17 | 21 | 56 | 21 | 35 | 21 | 13 | 20 | 51 | 20 | 29 | 20 | 7 | 19 | 44 |
| *Seginus* ... | 23 | 56 | 23 | 36 | 23 | 16 | 22 | 55 | 22 | 35 | 22 | 13 | 21 | 52 | 21 | 30 | 21 | 8 | 20 | 46 | 20 | 24 | 20 | 2 |
| α Centaur... | 0 | 3 | 23 | 39 | 23 | 19 | 22 | 59 | 22 | 38 | 22 | 17 | 21 | 55 | 21 | 33 | 21 | 12 | 20 | 49 | 20 | 27 | 20 | 5 |
| *Zubenesch* . | 0 | 16 | 23 | 54 | 23 | 32 | 23 | 11 | 22 | 51 | 22 | 29 | 22 | 8 | 21 | 46 | 21 | 24 | 21 | 2 | 20 | 40 | 20 | 18 |
| *Zubenelg* .. | 0 | 42 | 0 | 23 | 0 | 2 | 23 | 38 | 23 | 17 | 22 | 56 | 22 | 35 | 22 | 13 | 21 | 51 | 21 | 29 | 21 | 7 | 20 | 44 |
| *Alphacca* .. | 1 | 2 | 0 | 42 | 0 | 22 | 23 | 58 | 23 | 37 | 23 | 16 | 22 | 54 | 22 | 33 | 22 | 11 | 21 | 48 | 21 | 26 | 21 | 4 |
| α Serpens ... | 1 | 19 | 0 | 51 | 0 | 31 | 0 | 10 | 23 | 45 | 23 | 24 | 23 | 3 | 22 | 41 | 22 | 19 | 21 | 57 | 21 | 35 | 21 | 12 |
| ANTARES .. | 1 | 53 | 1 | 34 | 1 | 13 | 0 | 53 | 0 | 32 | 0 | 11 | 23 | 46 | 23 | 24 | 23 | 2 | 22 | 40 | 22 | 18 | 21 | 55 |
| *Ras Algethi* | 2 | 41 | 2 | 22 | 2 | 2 | 1 | 41 | 1 | 20 | 0 | 59 | 0 | 38 | 0 | 16 | 23 | 50 | 23 | 28 | 23 | 6 | 22 | 43 |
| *Ras Alhague* | 3 | 2 | 2 | 42 | 2 | 22 | 2 | 1 | 1 | 40 | 1 | 19 | 0 | 58 | 0 | 36 | 0 | 14 | 23 | 48 | 23 | 26 | 23 | 4 |
| *Rastaban* .. | 3 | 26 | 3 | 8 | 2 | 48 | 2 | 27 | 2 | 6 | 1 | 45 | 1 | 24 | 1 | 2 | 0 | 40 | 0 | 18 | 23 | 52 | 23 | 29 |
| *Vega* ..... | 4 | 5 | 3 | 45 | 3 | 25 | 3 | 5 | 2 | 45 | 2 | 23 | 2 | 2 | 1 | 40 | 1 | 18 | 0 | 56 | 0 | 34 | 0 | 12 |
| α AQUILÆ ... | 5 | 16 | 4 | 56 | 4 | 36 | 4 | 16 | 3 | 55 | 3 | 34 | 3 | 12 | 2 | 51 | 2 | 30 | 2 | 7 | 1 | 45 | 1 | 23 |
| α PAVO ..... | 5 | 45 | 5 | 26 | 5 | 5 | 4 | 45 | 4 | 24 | 4 | 3 | 3 | 42 | 3 | 20 | 2 | 58 | 2 | 37 | 2 | 15 | 1 | 52 |
| *Deneb*..... | 6 | 9 | 5 | 49 | 5 | 29 | 5 | 9 | 4 | 48 | 4 | 27 | 4 | 5 | 3 | 44 | 3 | 22 | 3 | 0 | 2 | 39 | 2 | 16 |
| *Alderamin*. | 6 | 48 | 6 | 28 | 6 | 8 | 5 | 48 | 5 | 27 | 5 | 6 | 4 | 44 | 4 | 23 | 4 | 1 | 3 | 39 | 3 | 16 | 2 | 54 |
| α Aquarius.. | 7 | 30 | 7 | 11 | 6 | 51 | 6 | 30 | 6 | 9 | 5 | 48 | 5 | 27 | 5 | 5 | 4 | 43 | 4 | 21 | 3 | 59 | 3 | 37 |
| α GRUX ..... | 7 | 31 | 7 | 11 | 6 | 51 | 6 | 30 | 6 | 10 | 5 | 48 | 5 | 27 | 5 | 5 | 4 | 43 | 4 | 21 | 3 | 59 | 3 | 37 |
| FOMALHAUT | 8 | 22 | 8 | 2 | 7 | 42 | 7 | 21 | 7 | 0 | 6 | 39 | 6 | 18 | 5 | 56 | 5 | 34 | 5 | 12 | 4 | 50 | 4 | 28 |
| *Scheat* .... | 8 | 29 | 8 | 9 | 7 | 49 | 7 | 29 | 7 | 8 | 6 | 47 | 6 | 25 | 6 | 3 | 5 | 42 | 5 | 19 | 4 | 57 | 4 | 35 |
| MARCAB... | 8 | 30 | 8 | 10 | 7 | 50 | 7 | 29 | 7 | 9 | 6 | 47 | 6 | 26 | 6 | 4 | 5 | 42 | 5 | 20 | 4 | 58 | 4 | 36 |
| *Alpheratz*.. | 9 | 32 | 9 | 12 | 8 | 53 | 8 | 33 | 8 | 12 | 7 | 51 | 7 | 29 | 7 | 8 | 6 | 46 | 6 | 24 | 6 | 0 | 5 | 39 |

# TABLE XLV.

## For finding the TIME most advantageous for observing the Altitude of the Sun or a Star, in order to ascertain the Apparent Time.

| Lat. | Declination of the same name with the Latitude. | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0° | | 2° | | 4° | | 6° | | 8° | | 10° | | 12° | | 14° | | 16° | |
| ° | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. | h. | m. |
| 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 |
| 1 | 6 | 0 | 4 | 0 | 5 | 2 | 5 | 22 | 5 | 31 | 5 | 37 | 5 | 41 | 5 | 44 | 5 | 46 |
| 2 | 6 | 0 | 0 | 0 | 4 | 0 | 4 | 42 | 5 | 2 | 5 | 14 | 5 | 22 | 5 | 28 | 5 | 32 |
| 3 | 6 | 0 | 3 | 13 | 2 | 46 | 4 | 0 | 4 | 32 | 4 | 51 | 5 | 3 | 5 | 11 | 5 | 18 |
| 4 | 6 | 0 | 4 | 0 | 0 | 0 | 3 | 13 | 4 | 1 | 4 | 27 | 4 | 43 | 4 | 55 | 5 | 4 |
| 5 | 6 | 0 | 4 | 26 | 2 | 28 | 2 | 15 | 3 | 26 | 4 | 1 | 4 | 23 | 4 | 38 | 4 | 49 |
| 6 | 6 | 0 | 4 | 42 | 3 | 13 | 0 | 0 | 2 | 46 | 3 | 34 | 4 | 1 | 4 | 20 | 4 | 34 |
| 7 | 6 | 0 | 4 | 54 | 3 | 41 | 2 | 5 | 1 | 56 | 2 | 3 | 3 | 39 | 4 | 2 | 4 | 19 |
| 8 | 6 | 0 | 5 | 2 | 4 | 1 | 2 | 46 | 0 | 0 | 2 | 29 | 3 | 14 | 3 | 43 | 4 | 3 |
| 9 | 6 | 0 | 5 | 9 | 4 | 15 | 3 | 14 | 1 | 50 | 1 | 44 | 2 | 47 | 3 | 22 | 3 | 46 |
| 10 | 6 | 0 | 5 | 14 | 4 | 27 | 3 | 34 | 2 | 29 | 0 | 0 | 2 | 16 | 3 | 0 | 3 | 28 |
| 11 | 6 | 0 | 5 | 19 | 4 | 36 | 3 | 49 | 2 | 55 | 1 | 40 | 1 | 35 | 2 | 35 | 3 | 9 |
| 12 | 6 | 0 | 5 | 22 | 4 | 43 | 4 | 1 | 3 | 14 | 2 | 16 | 0 | 0 | 2 | 6 | 2 | 49 |
| 13 | 6 | 0 | 5 | 25 | 4 | 49 | 4 | 12 | 3 | 30 | 2 | 41 | 1 | 32 | 1 | 29 | 2 | 26 |
| 14 | 6 | 0 | 5 | 28 | 4 | 55 | 4 | 20 | 3 | 43 | 3 | 0 | 2 | 6 | 0 | 0 | 1 | 58 |
| 15 | 6 | 0 | 5 | 30 | 4 | 59 | 4 | 28 | 3 | 53 | 3 | 15 | 2 | 30 | 1 | 26 | 1 | 23 |
| 16 | 6 | 0 | 5 | 32 | 5 | 4 | 4 | 34 | 4 | 3 | 3 | 28 | 2 | 49 | 1 | 58 | 0 | 0 |
| 17 | 6 | 0 | 5 | 34 | 5 | 7 | 4 | 40 | 4 | 11 | 3 | 39 | 3 | 4 | 2 | 21 | 1 | 21 |
| 18 | 6 | 0 | 5 | 35 | 5 | 10 | 4 | 45 | 4 | 17 | 3 | 49 | 3 | 17 | 2 | 40 | 1 | 52 |
| 19 | 6 | 0 | 5 | 37 | 5 | 13 | 4 | 49 | 4 | 24 | 3 | 57 | 3 | 28 | 2 | 54 | 2 | 14 |
| 20 | 6 | 0 | 5 | 38 | 5 | 16 | 4 | 53 | 4 | 29 | 4 | 4 | 3 | 37 | 3 | 7 | 2 | 32 |
| 21 | 6 | 0 | 5 | 39 | 5 | 18 | 4 | 56 | 4 | 34 | 4 | 11 | 3 | 46 | 3 | 18 | 2 | 47 |
| 22 | 6 | 0 | 5 | 40 | 5 | 20 | 5 | 0 | 4 | 39 | 4 | 16 | 3 | 53 | 3 | 28 | 2 | 59 |
| 23 | 6 | 0 | 5 | 41 | 5 | 22 | 5 | 3 | 4 | 43 | 4 | 22 | 4 | 0 | 3 | 36 | 3 | 10 |
| 24 | 6 | 0 | 5 | 42 | 5 | 24 | 5 | 5 | 4 | 46 | 4 | 27 | 4 | 6 | 3 | 44 | 3 | 20 |
| 25 | 6 | 0 | 5 | 43 | 5 | 26 | 5 | 8 | 4 | 50 | 4 | 31 | 4 | 12 | 3 | 51 | 3 | 28 |
| 26 | 6 | 0 | 5 | 44 | 5 | 27 | 5 | 10 | 4 | 53 | 4 | 35 | 4 | 17 | 3 | 57 | 3 | 36 |
| 27 | 6 | 0 | 5 | 44 | 5 | 28 | 5 | 12 | 4 | 56 | 4 | 39 | 4 | 21 | 4 | 3 | 3 | 43 |
| 28 | 6 | 0 | 5 | 45 | 5 | 30 | 5 | 14 | 4 | 59 | 4 | 43 | 4 | 26 | 4 | 8 | 3 | 49 |
| 29 | 6 | 0 | 5 | 46 | 5 | 31 | 5 | 16 | 5 | 1 | 4 | 46 | 4 | 30 | 4 | 13 | 3 | 55 |
| 30 | 6 | 0 | 5 | 46 | 5 | 32 | 5 | 18 | 5 | 4 | 4 | 49 | 4 | 34 | 4 | 18 | 4 | 1 |
| 31 | 6 | 0 | 5 | 47 | 5 | 33 | 5 | 20 | 5 | 6 | 4 | 52 | 4 | 37 | 4 | 22 | 4 | 6 |
| 32 | 6 | 0 | 5 | 47 | 5 | 34 | 5 | 21 | 5 | 8 | 4 | 54 | 4 | 40 | 4 | 26 | 4 | 11 |
| 33 | 6 | 0 | 5 | 48 | 5 | 35 | 5 | 23 | 5 | 10 | 4 | 57 | 4 | 44 | 4 | 30 | 4 | 15 |
| 34 | 6 | 0 | 5 | 48 | 5 | 36 | 5 | 24 | 5 | 12 | 4 | 59 | 4 | 47 | 4 | 33 | 4 | 19 |
| 35 | 6 | 0 | 5 | 49 | 5 | 37 | 5 | 25 | 5 | 14 | 5 | 2 | 4 | 49 | 4 | 37 | 4 | 23 |
| 36 | 6 | 0 | 5 | 49 | 5 | 38 | 5 | 27 | 5 | 15 | 5 | 4 | 4 | 52 | 4 | 40 | 4 | 27 |
| 37 | 6 | 0 | 5 | 49 | 5 | 39 | 5 | 28 | 5 | 17 | 5 | 6 | 4 | 54 | 4 | 43 | 4 | 31 |
| 38 | 6 | 0 | 5 | 50 | 5 | 39 | 5 | 29 | 5 | 19 | 5 | 8 | 4 | 57 | 4 | 46 | 4 | 34 |
| 39 | 6 | 0 | 5 | 50 | 5 | 40 | 5 | 30 | 5 | 20 | 5 | 10 | 4 | 59 | 4 | 48 | 4 | 37 |
| 40 | 6 | 0 | 5 | 50 | 5 | 41 | 5 | 31 | 5 | 21 | 5 | 11 | 5 | 1 | 4 | 51 | 4 | 40 |
| 41 | 6 | 0 | 5 | 51 | 5 | 42 | 5 | 32 | 5 | 23 | 5 | 13 | 5 | 3 | 4 | 53 | 4 | 43 |
| 42 | 6 | 0 | 5 | 51 | 5 | 42 | 5 | 33 | 5 | 24 | 5 | 15 | 5 | 5 | 4 | 56 | 4 | 46 |
| 43 | 6 | 0 | 5 | 51 | 5 | 43 | 5 | 34 | 5 | 25 | 5 | 16 | 5 | 7 | 4 | 58 | 4 | 48 |
| 44 | 6 | 0 | 5 | 52 | 5 | 43 | 5 | 35 | 5 | 27 | 5 | 18 | 5 | 9 | 5 | 0 | 4 | 51 |
| 45 | 6 | 0 | 5 | 52 | 5 | 44 | 5 | 36 | 5 | 28 | 5 | 19 | 5 | 11 | 5 | 2 | 4 | 53 |
| 46 | 6 | 0 | 5 | 52 | 5 | 45 | 5 | 37 | 5 | 29 | 5 | 21 | 5 | 13 | 5 | 4 | 4 | 56 |
| 47 | 6 | 0 | 5 | 53 | 5 | 45 | 5 | 38 | 5 | 30 | 5 | 22 | 5 | 14 | 5 | 6 | 4 | 58 |
| 48 | 6 | 0 | 5 | 53 | 5 | 46 | 5 | 38 | 5 | 31 | 5 | 23 | 5 | 16 | 5 | 8 | 5 | 0 |
| 49 | 6 | 0 | 5 | 53 | 5 | 46 | 5 | 39 | 5 | 32 | 5 | 25 | 5 | 17 | 5 | 10 | 5 | 2 |
| 50 | 6 | 0 | 5 | 53 | 5 | 47 | 5 | 40 | 5 | 33 | 5 | 26 | 5 | 19 | 5 | 12 | 5 | 4 |
| 52 | 6 | 0 | 5 | 54 | 5 | 47 | 5 | 41 | 5 | 35 | 5 | 28 | 5 | 22 | 5 | 15 | 5 | 8 |
| 54 | 6 | 0 | 5 | 54 | 5 | 48 | 5 | 42 | 5 | 37 | 5 | 31 | 5 | 24 | 5 | 18 | 5 | 12 |
| 56 | 6 | 0 | 5 | 55 | 5 | 49 | 5 | 44 | 5 | 38 | 5 | 33 | 5 | 27 | 5 | 21 | 5 | 15 |
| 58 | 6 | 0 | 5 | 55 | 5 | 50 | 5 | 45 | 5 | 40 | 5 | 35 | 5 | 29 | 5 | 24 | 5 | 19 |
| 60 | 6 | 0 | 5 | 56 | 5 | 51 | 5 | 46 | 5 | 41 | 5 | 37 | 5 | 32 | 5 | 27 | 5 | 22 |
| 62 | 6 | 0 | 5 | 56 | 5 | 51 | 5 | 47 | 5 | 43 | 5 | 38 | 5 | 34 | 5 | 30 | 5 | 25 |
| 64 | 6 | 0 | 5 | 56 | 5 | 52 | 5 | 48 | 5 | 44 | 5 | 40 | 5 | 36 | 5 | 32 | 5 | 28 |
| 66 | 6 | 0 | 5 | 56 | 5 | 53 | 5 | 49 | 5 | 46 | 5 | 42 | 5 | 38 | 5 | 35 | 5 | 31 |
| 68 | 6 | 0 | 5 | 57 | 5 | 54 | 5 | 50 | 5 | 47 | 5 | 44 | 5 | 40 | 5 | 37 | 5 | 33 |
| 70 | 6 | 0 | 5 | 57 | 5 | 54 | 5 | 51 | 5 | 48 | 5 | 45 | 5 | 42 | 5 | 39 | 5 | 36 |

| Lat. | 18° | | 20° | | 22° | | 24° | |
|---|---|---|---|---|---|---|---|---|
| ° | h. | m. | h. | m. | h. | m. | h. | m. |
| 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 |
| 1 | 5 | 48 | 5 | 49 | 5 | 50 | 5 | 51 |
| 2 | 5 | 35 | 5 | 38 | 5 | 40 | 5 | 42 |
| 3 | 5 | 23 | 5 | 27 | 5 | 30 | 5 | 33 |
| 4 | 5 | 10 | 5 | 16 | 5 | 20 | 5 | 24 |
| 5 | 4 | 58 | 5 | 4 | 5 | 10 | 5 | 15 |
| 6 | 4 | 45 | 4 | 53 | 5 | 0 | 5 | 5 |
| 7 | 4 | 31 | 4 | 41 | 4 | 49 | 4 | 56 |
| 8 | 4 | 17 | 4 | 29 | 4 | 39 | 4 | 46 |
| 9 | 4 | 3 | 4 | 17 | 4 | 28 | 4 | 37 |
| 10 | 3 | 49 | 4 | 4 | 4 | 16 | 4 | 27 |
| 11 | 3 | 33 | 3 | 51 | 4 | 5 | 4 | 16 |
| 12 | 3 | 17 | 3 | 37 | 3 | 53 | 4 | 6 |
| 13 | 2 | 59 | 3 | 23 | 3 | 41 | 3 | 55 |
| 14 | 2 | 40 | 3 | 7 | 3 | 28 | 3 | 44 |
| 15 | 2 | 18 | 2 | 50 | 3 | 14 | 3 | 32 |
| 16 | 1 | 52 | 2 | 32 | 2 | 59 | 3 | 20 |
| 17 | 1 | 19 | 2 | 11 | 2 | 43 | 3 | 7 |
| 18 | 0 | 0 | 1 | 47 | 2 | 26 | 2 | 53 |
| 19 | 1 | 17 | 1 | 16 | 2 | 6 | 2 | 37 |
| 20 | 1 | 47 | 0 | 0 | 1 | 43 | 2 | 21 |
| 21 | 2 | 9 | 1 | 14 | 1 | 13 | 2 | 2 |
| 22 | 2 | 26 | 1 | 43 | 0 | 0 | 1 | 39 |
| 23 | 2 | 40 | 2 | 4 | 1 | 11 | 1 | 10 |
| 24 | 2 | 53 | 2 | 21 | 1 | 39 | 0 | 0 |
| 25 | 3 | 3 | 2 | 35 | 2 | 0 | 1 | 9 |
| 26 | 3 | 13 | 2 | 47 | 2 | 16 | 1 | 36 |
| 27 | 3 | 22 | 3 | 0 | 2 | 30 | 1 | 56 |
| 28 | 3 | 29 | 3 | 7 | 2 | 42 | 2 | 13 |
| 29 | 3 | 36 | 3 | 16 | 2 | 53 | 2 | 26 |
| 30 | 3 | 43 | 3 | 24 | 3 | 2 | 2 | 38 |
| 31 | 3 | 49 | 3 | 31 | 3 | 11 | 2 | 49 |
| 32 | 3 | 55 | 3 | 38 | 3 | 19 | 2 | 58 |
| 33 | 4 | 0 | 3 | 44 | 3 | 26 | 3 | 7 |
| 34 | 4 | 5 | 3 | 49 | 3 | 33 | 3 | 15 |
| 35 | 4 | 9 | 3 | 55 | 3 | 39 | 3 | 22 |
| 36 | 4 | 14 | 4 | 0 | 3 | 45 | 3 | 29 |
| 37 | 4 | 18 | 4 | 4 | 3 | 50 | 3 | 35 |
| 38 | 4 | 22 | 4 | 9 | 3 | 55 | 3 | 41 |
| 39 | 4 | 25 | 4 | 13 | 4 | 0 | 3 | 47 |
| 40 | 4 | 29 | 4 | 17 | 4 | 5 | 3 | 52 |
| 41 | 4 | 32 | 4 | 21 | 4 | 9 | 3 | 57 |
| 42 | 4 | 35 | 4 | 25 | 4 | 13 | 4 | 1 |
| 43 | 4 | 38 | 4 | 28 | 4 | 17 | 4 | 6 |
| 44 | 4 | 41 | 4 | 31 | 4 | 21 | 4 | 10 |
| 45 | 4 | 44 | 4 | 35 | 4 | 25 | 4 | 14 |
| 46 | 4 | 47 | 4 | 38 | 4 | 28 | 4 | 18 |
| 47 | 4 | 49 | 4 | 41 | 4 | 31 | 4 | 22 |
| 48 | 4 | 52 | 4 | 43 | 4 | 35 | 4 | 25 |
| 49 | 4 | 54 | 4 | 46 | 4 | 38 | 4 | 29 |
| 50 | 4 | 57 | 4 | 49 | 4 | 41 | 4 | 32 |
| 52 | 5 | 1 | 4 | 54 | 4 | 46 | 4 | 39 |
| 54 | 5 | 5 | 4 | 59 | 4 | 52 | 4 | 45 |
| 56 | 5 | 9 | 5 | 3 | 4 | 57 | 4 | 50 |
| 58 | 5 | 13 | 5 | 7 | 5 | 2 | 4 | 55 |
| 60 | 5 | 17 | 5 | 11 | 5 | 6 | 5 | 0 |
| 62 | 5 | 20 | 5 | 15 | 5 | 10 | 5 | 5 |
| 64 | 5 | 24 | 5 | 19 | 5 | 15 | 5 | 10 |
| 66 | 5 | 27 | 5 | 23 | 5 | 19 | 5 | 14 |
| 68 | 5 | 30 | 5 | 26 | 5 | 22 | 5 | 19 |
| 70 | 5 | 33 | 5 | 30 | 5 | 26 | 5 | 23 |

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# TABLE XLV.

**For finding the TIME most advantageous for observing the Altitude of the Sun or a Star, in order to ascertain the Apparent Time.**

| Lat. | Declination of the same name with the Latitude. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 26° | 28° | 30° | 32° | 34° | 36° | 38° | 40° | 42° | 44° | 46° | 48° | 50° |
| ° | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. |
| 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 | 6 0 |
| 1 | 5 52 | 5 52 | 5 53 | 5 54 | 5 54 | 5 54 | 5 55 | 5 55 | 5 56 | 5 56 | 5 56 | 5 56 | 5 57 |
| 2 | 5 44 | 5 45 | 5 46 | 5 47 | 5 48 | 5 49 | 5 50 | 5 50 | 5 51 | 5 52 | 5 52 | 5 53 | 5 53 |
| 3 | 5 35 | 5 37 | 5 39 | 5 41 | 5 42 | 5 43 | 5 45 | 5 46 | 5 47 | 5 48 | 5 48 | 5 49 | 5 50 |
| 4 | 5 27 | 5 30 | 5 32 | 5 34 | 5 36 | 5 38 | 5 39 | 5 41 | 5 42 | 5 43 | 5 45 | 5 46 | 5 47 |
| 5 | 5 19 | 5 22 | 5 25 | 5 28 | 5 30 | 5 32 | 5 34 | 5 36 | 5 38 | 5 39 | 5 41 | 5 42 | 5 43 |
| 6 | 5 10 | 5 14 | 5 18 | 5 21 | 5 24 | 5 27 | 5 29 | 5 31 | 5 33 | 5 35 | 5 37 | 5 38 | 5 40 |
| 7 | 5 2 | 5 7 | 5 11 | 5 15 | 5 18 | 5 21 | 5 24 | 5 26 | 5 29 | 5 31 | 5 33 | 5 35 | 5 36 |
| 8 | 4 53 | 4 59 | 5 4 | 5 8 | 5 12 | 5 15 | 5 19 | 5 21 | 5 24 | 5 27 | 5 29 | 5 31 | 5 33 |
| 9 | 4 44 | 4 51 | 4 56 | 5 1 | 5 6 | 5 10 | 5 13 | 5 16 | 5 19 | 5 22 | 5 25 | 5 27 | 5 29 |
| 10 | 4 35 | 4 43 | 4 49 | 4 54 | 4 59 | 5 4 | 5 8 | 5 11 | 5 15 | 5 18 | 5 21 | 5 23 | 5 26 |
| 11 | 4 26 | 4 34 | 4 41 | 4 48 | 4 53 | 4 58 | 5 2 | 5 6 | 5 10 | 5 14 | 5 17 | 5 20 | 5 22 |
| 12 | 4 17 | 4 26 | 4 34 | 4 40 | 4 47 | 4 52 | 4 57 | 5 1 | 5 5 | 5 9 | 5 13 | 5 16 | 5 19 |
| 13 | 4 7 | 4 17 | 4 26 | 4 33 | 4 40 | 4 46 | 4 51 | 4 56 | 5 1 | 5 5 | 5 8 | 5 12 | 5 15 |
| 14 | 3 57 | 4 8 | 4 18 | 4 26 | 4 33 | 4 40 | 4 46 | 4 51 | 4 56 | 5 0 | 5 4 | 5 8 | 5 12 |
| 15 | 3 47 | 3 59 | 4 9 | 4 18 | 4 26 | 4 33 | 4 40 | 4 46 | 4 51 | 4 56 | 5 0 | 5 4 | 5 8 |
| 16 | 3 36 | 3 49 | 4 1 | 4 11 | 4 19 | 4 27 | 4 34 | 4 40 | 4 46 | 4 51 | 4 56 | 5 0 | 5 4 |
| 17 | 3 25 | 3 40 | 3 52 | 4 3 | 4 12 | 4 20 | 4 28 | 4 35 | 4 41 | 4 46 | 4 51 | 4 56 | 5 1 |
| 18 | 3 13 | 3 29 | 3 43 | 3 55 | 4 5 | 4 14 | 4 22 | 4 29 | 4 35 | 4 41 | 4 47 | 4 52 | 4 57 |
| 19 | 3 0 | 3 19 | 3 34 | 3 46 | 3 57 | 4 7 | 4 15 | 4 23 | 4 30 | 4 36 | 4 42 | 4 48 | 4 53 |
| 20 | 2 47 | 3 7 | 3 24 | 3 38 | 3 49 | 4 0 | 4 9 | 4 17 | 4 25 | 4 31 | 4 38 | 4 43 | 4 49 |
| 21 | 2 32 | 2 55 | 3 13 | 3 28 | 3 41 | 3 52 | 4 2 | 4 11 | 4 19 | 4 26 | 4 33 | 4 39 | 4 45 |
| 22 | 2 16 | 2 42 | 3 2 | 3 19 | 3 33 | 3 45 | 3 55 | 4 5 | 4 13 | 4 21 | 4 28 | 4 35 | 4 41 |
| 23 | 1 58 | 2 28 | 2 51 | 3 9 | 3 24 | 3 37 | 3 48 | 3 58 | 4 7 | 4 16 | 4 23 | 4 30 | 4 37 |
| 24 | 1 36 | 2 13 | 2 38 | 2 58 | 3 15 | 3 29 | 3 41 | 3 52 | 4 1 | 4 10 | 4 18 | 4 25 | 4 32 |
| 25 | 1 8 | 1 55 | 2 25 | 2 47 | 3 5 | 3 20 | 3 33 | 3 45 | 3 55 | 4 5 | 4 13 | 4 21 | 4 28 |
| 26 | 0 0 | 1 34 | 2 9 | 2 35 | 2 55 | 3 11 | 3 25 | 3 38 | 3 49 | 3 59 | 4 8 | 4 16 | 4 23 |
| 27 | 1 7 | 1 6 | 1 52 | 2 21 | 2 44 | 3 2 | 3 17 | 3 30 | 3 42 | 3 53 | 4 2 | 4 11 | 4 19 |
| 28 | 1 34 | 0 0 | 1 32 | 2 7 | 2 32 | 2 52 | 3 8 | 3 23 | 3 35 | 3 46 | 3 56 | 4 6 | 4 14 |
| 29 | 1 53 | 1 6 | 1 5 | 1 50 | 2 19 | 2 41 | 2 59 | 3 15 | 3 28 | 3 40 | 3 50 | 4 0 | 4 9 |
| 30 | 2 9 | 1 32 | 0 0 | 1 30 | 2 5 | 2 30 | 2 49 | 3 6 | 3 20 | 3 33 | 3 44 | 3 55 | 4 4 |
| 31 | 2 23 | 1 51 | 1 4 | 1 4 | 1 48 | 2 17 | 2 39 | 2 57 | 3 13 | 3 26 | 3 38 | 3 49 | 3 59 |
| 32 | 2 35 | 2 7 | 1 30 | 0 0 | 1 28 | 2 3 | 2 28 | 2 47 | 3 4 | 3 19 | 3 32 | 3 43 | 3 54 |
| 33 | 2 45 | 2 20 | 1 49 | 1 3 | 1 3 | 1 47 | 2 15 | 2 37 | 2 55 | 3 11 | 3 25 | 3 37 | 3 48 |
| 34 | 2 55 | 2 32 | 2 5 | 1 28 | 0 0 | 1 27 | 2 1 | 2 26 | 2 46 | 3 3 | 3 17 | 3 30 | 3 42 |
| 35 | 3 3 | 2 42 | 2 18 | 1 47 | 1 2 | 1 2 | 1 45 | 2 14 | 2 36 | 2 54 | 3 10 | 3 24 | 3 36 |
| 36 | 3 11 | 2 52 | 2 30 | 2 3 | 1 27 | 0 0 | 1 26 | 2 0 | 2 25 | 2 45 | 3 2 | 3 17 | 3 30 |
| 37 | 3 19 | 3 0 | 2 40 | 2 16 | 1 46 | 1 2 | 1 1 | 1 44 | 2 13 | 2 35 | 2 53 | 3 9 | 3 23 |
| 38 | 3 25 | 3 8 | 2 49 | 2 28 | 2 1 | 1 26 | 0 0 | 1 26 | 1 59 | 2 24 | 2 44 | 3 1 | 3 16 |
| 39 | 3 32 | 3 16 | 2 58 | 2 38 | 2 14 | 1 45 | 1 1 | 1 1 | 1 44 | 2 12 | 2 34 | 2 53 | 3 9 |
| 40 | 3 38 | 3 23 | 3 6 | 2 47 | 2 26 | 2 0 | 1 26 | 0 0 | 1 25 | 1 59 | 2 23 | 2 44 | 3 1 |
| 41 | 3 43 | 3 29 | 3 14 | 2 56 | 2 36 | 2 13 | 1 44 | 1 1 | 1 0 | 1 43 | 2 12 | 2 34 | 2 53 |
| 42 | 3 49 | 3 35 | 3 20 | 3 4 | 2 46 | 2 25 | 1 59 | 1 25 | 0 0 | 1 25 | 1 58 | 2 23 | 2 44 |
| 43 | 3 54 | 3 41 | 3 27 | 3 12 | 2 55 | 2 35 | 2 12 | 1 43 | 1 0 | 1 0 | 1 43 | 2 12 | 2 34 |
| 44 | 3 59 | 3 46 | 3 33 | 3 19 | 3 4 | 2 45 | 2 24 | 1 59 | 1 25 | 0 0 | 1 25 | 1 58 | 2 23 |
| 45 | 4 3 | 3 52 | 3 39 | 3 25 | 3 10 | 2 54 | 2 34 | 2 12 | 1 43 | 1 0 | 1 0 | 1 43 | 2 12 |
| 46 | 4 8 | 3 56 | 3 44 | 3 32 | 3 17 | 3 2 | 2 44 | 2 23 | 1 58 | 1 25 | 0 0 | 1 25 | 1 59 |
| 47 | 4 12 | 4 1 | 3 50 | 3 37 | 3 24 | 3 9 | 2 53 | 2 34 | 2 12 | 1 43 | 1 0 | 1 0 | 1 43 |
| 48 | 4 16 | 4 6 | 3 55 | 3 43 | 3 30 | 3 17 | 3 1 | 2 44 | 2 23 | 1 58 | 1 25 | 0 0 | 1 25 |
| 49 | 4 20 | 4 10 | 4 0 | 3 48 | 3 36 | 3 23 | 3 9 | 2 53 | 2 34 | 2 12 | 1 43 | 1 0 | 1 0 |
| 50 | 4 23 | 4 14 | 4 4 | 3 54 | 3 42 | 3 30 | 3 16 | 3 1 | 2 44 | 2 23 | 1 59 | 1 25 | 0 0 |
| 52 | 4 30 | 4 22 | 4 13 | 4 3 | 3 53 | 3 42 | 3 30 | 3 16 | 3 1 | 2 44 | 2 24 | 1 59 | 1 26 |
| 54 | 4 37 | 4 29 | 4 21 | 4 12 | 4 3 | 3 53 | 3 42 | 3 30 | 3 17 | 3 2 | 2 45 | 2 25 | 2 0 |
| 56 | 4 43 | 4 36 | 4 28 | 4 20 | 4 12 | 4 3 | 3 53 | 3 42 | 3 30 | 3 17 | 3 3 | 2 46 | 2 26 |
| 58 | 4 49 | 4 42 | 4 35 | 4 28 | 4 20 | 4 12 | 4 3 | 3 54 | 3 43 | 3 32 | 3 19 | 3 4 | 2 47 |
| 60 | 4 55 | 4 48 | 4 42 | 4 35 | 4 28 | 4 21 | 4 13 | 4 4 | 3 55 | 3 44 | 3 33 | 3 20 | 3 6 |
| 62 | 5 0 | 4 54 | 4 48 | 4 42 | 4 36 | 4 29 | 4 22 | 4 14 | 4 6 | 3 56 | 3 46 | 3 35 | 3 23 |
| 64 | 5 5 | 5 0 | 4 55 | 4 49 | 4 43 | 4 37 | 4 30 | 4 23 | 4 16 | 4 8 | 3 59 | 3 49 | 3 38 |
| 66 | 5 10 | 5 5 | 5 0 | 4 55 | 4 50 | 4 45 | 4 39 | 4 32 | 4 25 | 4 18 | 4 10 | 4 1 | 3 52 |
| 68 | 5 15 | 5 10 | 5 6 | 5 2 | 4 57 | 4 52 | 4 46 | 4 41 | 4 35 | 4 28 | 4 21 | 4 13 | 4 5 |
| 70 | 5 19 | 5 15 | 5 11 | 5 7 | 5 3 | 4 59 | 4 54 | 4 49 | 4 43 | 4 38 | 4 31 | 4 22 | 4 17 |

# TABLE XLVI.

## For finding the ALTITUDE of the Sun or a Star most advantageous for ascertaining the Apparent Time.

| Lat. | Declination of the same name with the Latitude. | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0° | | 2° | | 4° | | 6° | | 8° | | 10° | | 12° | | 14° | | 16° | | 18° | | 20° | | 22° | | 24° | |
| ° | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 30 | 0 | 14 | 29 | 9 | 37 | 7 | 12 | 5 | 46 | 4 | 49 | 4 | 8 | 3 | 38 | 3 | 14 | 2 | 55 | 2 | 40 | 2 | 28 |
| 2 | 0 | 0 | 90 | 0 | 30 | 1 | 19 | 30 | 14 | 31 | 11 | 36 | 9 | 40 | 8 | 18 | 7 | 16 | 6 | 29 | 5 | 51 | 5 | 21 | 4 | 55 |
| 3 | 0 | 0 | 41 | 49 | 48 | 37 | 30 | 3 | 22 | 5 | 17 | 32 | 14 | 35 | 12 | 30 | 10 | 57 | 9 | 45 | 8 | 48 | 8 | 2 | 7 | 24 |
| 4 | 0 | 0 | 30 | 1 | 90 | 0 | 41 | 52 | 30 | 5 | 23 | 41 | 19 | 36 | 16 | 45 | 14 | 40 | 13 | 3 | 11 | 46 | 10 | 44 | 9 | 53 |
| 5 | 0 | 0 | 23 | 36 | 53 | 10 | 56 | 30 | 38 | 46 | 30 | 8 | 24 | 47 | 21 | 7 | 18 | 26 | 16 | 23 | 14 | 46 | 13 | 27 | 12 | 22 |
| 6 | 0 | 0 | 19 | 30 | 41 | 52 | 90 | 0 | 48 | 41 | 37 | 1 | 30 | 11 | 25 | 36 | 22 | 17 | 19 | 46 | 17 | 48 | 16 | 12 | 14 | 53 |
| 7 | 0 | 0 | 16 | 38 | 34 | 55 | 59 | 4 | 61 | 7 | 44 | 34 | 35 | 53 | 30 | 15 | 26 | 14 | 23 | 14 | 20 | 52 | 18 | 59 | 17 | 26 |
| 8 | 0 | 0 | 14 | 31 | 30 | 5 | 18 | 41 | 90 | 0 | 53 | 16 | 42 | 1 | 35 | 7 | 30 | 20 | 26 | 46 | 24 | 1 | 21 | 49 | 20 | 1 |
| 9 | 0 | 0 | 12 | 53 | 26 | 29 | 41 | 56 | 62 | 50 | 64 | 16 | 48 | 48 | 40 | 17 | 34 | 35 | 30 | 25 | 27 | 13 | 24 | 41 | 22 | 37 |
| 10 | 0 | 0 | 11 | 36 | 23 | 41 | 37 | 1 | 53 | 16 | 90 | 0 | 56 | 38 | 45 | 52 | 39 | 3 | 34 | 11 | 30 | 31 | 27 | 37 | 25 | 16 |
| 11 | 0 | 0 | 10 | 32 | 21 | 27 | 33 | 13 | 46 | 50 | 65 | 31 | 66 | 36 | 52 | 4 | 43 | 48 | 38 | 8 | 33 | 55 | 30 | 37 | 27 | 50 |
| 12 | 0 | 0 | 9 | 40 | 19 | 36 | 30 | 11 | 42 | 1 | 56 | 38 | 90 | 0 | 59 | 15 | 48 | 58 | 42 | 17 | 37 | 26 | 33 | 43 | 30 | 45 |
| 13 | 0 | 0 | 8 | 56 | 18 | 4 | 27 | 41 | 38 | 13 | 50 | 32 | 67 | 33 | 68 | 25 | 54 | 42 | 46 | 43 | 41 | 8 | 36 | 54 | 33 | 35 |
| 14 | 0 | 0 | 8 | 18 | 16 | 45 | 25 | 36 | 35 | 7 | 45 | 52 | 59 | 15 | 90 | 0 | 61 | 22 | 51 | 32 | 45 | 1 | 40 | 14 | 36 | 30 |
| 15 | 0 | 0 | 7 | 45 | 15 | 38 | 23 | 49 | 32 | 32 | 42 | 8 | 53 | 27 | 69 | 11 | 69 | 53 | 56 | 53 | 49 | 11 | 43 | 42 | 39 | 31 |
| 16 | 0 | 0 | 7 | 16 | 14 | 40 | 22 | 17 | 30 | 20 | 39 | 3 | 48 | 58 | 61 | 22 | 90 | 0 | 63 | 7 | 53 | 42 | 47 | 22 | 42 | 40 |
| 17 | 0 | 0 | 6 | 51 | 13 | 48 | 20 | 57 | 28 | 26 | 36 | 26 | 45 | 20 | 55 | 50 | 70 | 31 | 71 | 7 | 58 | 45 | 51 | 18 | 45 | 57 |
| 18 | 0 | 0 | 6 | 29 | 13 | 3 | 19 | 46 | 26 | 46 | 34 | 11 | 42 | 17 | 51 | 32 | 63 | 7 | 90 | 0 | 64 | 37 | 55 | 35 | 49 | 27 |
| 19 | 0 | 0 | 6 | 9 | 12 | 22 | 18 | 44 | 25 | 18 | 32 | 14 | 39 | 41 | 48 | 0 | 57 | 51 | 71 | 39 | 72 | 9 | 60 | 21 | 53 | 10 |
| 20 | 0 | 0 | 5 | 51 | 11 | 46 | 17 | 48 | 24 | 1 | 30 | 31 | 37 | 26 | 45 | 1 | 53 | 42 | 64 | 37 | 90 | 0 | 65 | 55 | 57 | 14 |
| 21 | 0 | 0 | 5 | 35 | 11 | 13 | 16 | 57 | 23 | 51 | 28 | 59 | 35 | 28 | 42 | 28 | 50 | 17 | 59 | 34 | 72 | 38 | 73 | 4 | 61 | 47 |
| 22 | 0 | 0 | 5 | 21 | 10 | 44 | 16 | 12 | 21 | 49 | 27 | 37 | 33 | 43 | 40 | 14 | 47 | 22 | 55 | 35 | 65 | 55 | 90 | 0 | 67 | 5 |
| 23 | 0 | 0 | 5 | 7 | 10 | 17 | 15 | 31 | 20 | 52 | 26 | 23 | 32 | 9 | 38 | 15 | 44 | 52 | 52 | 16 | 61 | 5 | 73 | 29 | 73 | 53 |
| 24 | 0 | 0 | 4 | 55 | 9 | 53 | 14 | 53 | 20 | 1 | 25 | 16 | 30 | 45 | 36 | 30 | 42 | 40 | 49 | 27 | 57 | 14 | 67 | 5 | 90 | 0 |
| 25 | 0 | 0 | 4 | 44 | 9 | 30 | 14 | 19 | 19 | 14 | 24 | 16 | 29 | 28 | 34 | 55 | 40 | 43 | 46 | 59 | 54 | 1 | 62 | 25 | 74 | 16 |
| 26 | 0 | 0 | 4 | 34 | 9 | 9 | 13 | 48 | 18 | 31 | 23 | 20 | 28 | 19 | 33 | 30 | 38 | 58 | 44 | 49 | 51 | 17 | 58 | 43 | 68 | 5 |
| 27 | 0 | 0 | 4 | 25 | 8 | 50 | 13 | 19 | 17 | 51 | 22 | 29 | 27 | 15 | 32 | 12 | 37 | 23 | 42 | 54 | 48 | 53 | 55 | 36 | 63 | 37 |
| 28 | 0 | 0 | 4 | 16 | 8 | 33 | 12 | 52 | 17 | 15 | 21 | 42 | 26 | 17 | 31 | 1 | 35 | 57 | 41 | 10 | 46 | 46 | 52 | 56 | 60 | 3 |
| 29 | 0 | 0 | 4 | 8 | 8 | 16 | 12 | 27 | 16 | 41 | 20 | 59 | 25 | 24 | 29 | 56 | 34 | 39 | 39 | 36 | 44 | 52 | 50 | 36 | 57 | 2 |
| 30 | 0 | 0 | 4 | 0 | 8 | 1 | 12 | 4 | 16 | 10 | 20 | 19 | 24 | 34 | 28 | 56 | 33 | 27 | 38 | 10 | 43 | 10 | 48 | 31 | 54 | 26 |
| 31 | 0 | 0 | 3 | 53 | 7 | 47 | 11 | 43 | 15 | 41 | 19 | 42 | 23 | 49 | 28 | 1 | 32 | 21 | 36 | 52 | 41 | 37 | 46 | 40 | 52 | 16 |
| 32 | 0 | 0 | 3 | 47 | 7 | 34 | 11 | 23 | 15 | 14 | 19 | 8 | 23 | 6 | 27 | 10 | 31 | 21 | 35 | 40 | 40 | 12 | 44 | 59 | 50 | 9 |
| 33 | 0 | 0 | 3 | 40 | 7 | 22 | 11 | 4 | 14 | 48 | 18 | 36 | 22 | 26 | 26 | 22 | 30 | 24 | 34 | 34 | 38 | 54 | 43 | 27 | 48 | 18 |
| 34 | 0 | 0 | 3 | 35 | 7 | 10 | 10 | 46 | 14 | 25 | 18 | 5 | 21 | 50 | 25 | 38 | 29 | 32 | 33 | 33 | 37 | 42 | 42 | 4 | 46 | 39 |
| 35 | 0 | 0 | 3 | 29 | 6 | 59 | 10 | 30 | 14 | 3 | 17 | 37 | 21 | 15 | 24 | 57 | 28 | 43 | 32 | 36 | 36 | 36 | 40 | 47 | 45 | 11 |
| 36 | 0 | 0 | 3 | 24 | 6 | 49 | 10 | 16 | 13 | 42 | 17 | 11 | 20 | 43 | 24 | 18 | 27 | 58 | 31 | 43 | 35 | 35 | 39 | 36 | 43 | 46 |
| 37 | 0 | 0 | 3 | 19 | 6 | 39 | 10 | 0 | 13 | 22 | 16 | 46 | 20 | 13 | 23 | 42 | 27 | 16 | 30 | 54 | 34 | 38 | 38 | 30 | 42 | 31 |
| 38 | 0 | 0 | 3 | 15 | 6 | 31 | 9 | 47 | 13 | 4 | 16 | 23 | 19 | 44 | 23 | 8 | 26 | 36 | 30 | 8 | 33 | 45 | 37 | 29 | 41 | 20 |
| 39 | 0 | 0 | 3 | 11 | 6 | 22 | 9 | 34 | 12 | 47 | 16 | 1 | 19 | 18 | 22 | 36 | 25 | 59 | 29 | 25 | 32 | 55 | 36 | 32 | 40 | 16 |
| 40 | 0 | 0 | 3 | 7 | 6 | 14 | 9 | 22 | 12 | 30 | 15 | 40 | 18 | 52 | 22 | 7 | 25 | 24 | 28 | 44 | 32 | 9 | 35 | 39 | 39 | 15 |
| 41 | 0 | 0 | 3 | 3 | 6 | 6 | 9 | 10 | 12 | 15 | 15 | 21 | 18 | 29 | 21 | 38 | 24 | 51 | 28 | 6 | 31 | 25 | 34 | 49 | 38 | 15 |
| 42 | 0 | 0 | 2 | 59 | 5 | 59 | 8 | 59 | 12 | 0 | 15 | 2 | 18 | 6 | 21 | 12 | 24 | 20 | 27 | 30 | 30 | 44 | 34 | 3 | 37 | 25 |
| 43 | 0 | 0 | 2 | 56 | 5 | 52 | 8 | 49 | 11 | 47 | 14 | 45 | 17 | 45 | 20 | 47 | 23 | 50 | 26 | 57 | 30 | 6 | 33 | 19 | 36 | 26 |
| 44 | 0 | 0 | 2 | 53 | 5 | 46 | 8 | 39 | 11 | 33 | 14 | 29 | 17 | 25 | 20 | 23 | 23 | 23 | 26 | 25 | 29 | 30 | 32 | 38 | 35 | 40 |
| 45 | 0 | 0 | 2 | 50 | 5 | 40 | 8 | 30 | 11 | 21 | 14 | 13 | 17 | 6 | 20 | 0 | 22 | 57 | 25 | 55 | 28 | 56 | 31 | 59 | 35 | 0 |
| 46 | 0 | 0 | 2 | 47 | 5 | 34 | 8 | 21 | 11 | 9 | 13 | 58 | 16 | 48 | 19 | 39 | 22 | 32 | 25 | 26 | 28 | 23 | 31 | 26 | 34 | 25 |
| 47 | 0 | 0 | 2 | 44 | 5 | 28 | 8 | 13 | 10 | 58 | 13 | 44 | 16 | 31 | 19 | 19 | 22 | 8 | 25 | 0 | 27 | 53 | 30 | 49 | 33 | 47 |
| 48 | 0 | 0 | 2 | 42 | 5 | 23 | 8 | 5 | 10 | 48 | 13 | 31 | 16 | 15 | 19 | 0 | 21 | 46 | 24 | 34 | 27 | 24 | 30 | 16 | 33 | 12 |
| 49 | 0 | 0 | 2 | 39 | 5 | 18 | 7 | 58 | 10 | 38 | 13 | 18 | 15 | 59 | 18 | 42 | 21 | 25 | 24 | 10 | 26 | 57 | 29 | 46 | 32 | 35 |
| 50 | 0 | 0 | 2 | 37 | 5 | 13 | 7 | 51 | 10 | 28 | 13 | 6 | 15 | 45 | 18 | 25 | 21 | 5 | 23 | 47 | 26 | 31 | 29 | 17 | 32 | 4 |
| 52 | 0 | 0 | 2 | 32 | 5 | 5 | 7 | 37 | 10 | 10 | 12 | 44 | 15 | 18 | 17 | 53 | 20 | 28 | 23 | 5 | 25 | 43 | 28 | 22 | 31 | 7 |
| 54 | 0 | 0 | 2 | 28 | 4 | 57 | 7 | 25 | 9 | 54 | 12 | 24 | 14 | 54 | 17 | 24 | 19 | 55 | 22 | 27 | 25 | 1 | 27 | 35 | 30 | 10 |
| 56 | 0 | 0 | 2 | 25 | 4 | 50 | 7 | 15 | 9 | 40 | 12 | 5 | 14 | 31 | 16 | 58 | 19 | 25 | 21 | 53 | 24 | 22 | 26 | 52 | 29 | 22 |
| 58 | 0 | 0 | 2 | 22 | 4 | 43 | 7 | 5 | 9 | 27 | 11 | 49 | 14 | 11 | 16 | 35 | 18 | 58 | 21 | 22 | 23 | 47 | 26 | 13 | 28 | 30 |
| 60 | 0 | 0 | 2 | 19 | 4 | 37 | 6 | 56 | 9 | 15 | 11 | 34 | 13 | 53 | 16 | 13 | 18 | 34 | 20 | 54 | 23 | 10 | 25 | 38 | 28 | 0 |
| 62 | 0 | 0 | 2 | 16 | 4 | 31 | 6 | 47 | 9 | 3 | 11 | 19 | 13 | 37 | 15 | 54 | 18 | 12 | 20 | 29 | 22 | 48 | 25 | 6 | 27 | 26 |
| 64 | 0 | 0 | 2 | 14 | 4 | 27 | 6 | 41 | 8 | 54 | 11 | 8 | 13 | 23 | 15 | 37 | 17 | 52 | 20 | 7 | 22 | 22 | 24 | 38 | 26 | 54 |
| 66 | 0 | 0 | 2 | 11 | 4 | 23 | 6 | 34 | 8 | 46 | 10 | 57 | 13 | 9 | 15 | 21 | 17 | 34 | 19 | 46 | 21 | 59 | 24 | 13 | 26 | 26 |
| 68 | 0 | 0 | 2 | 9 | 4 | 19 | 6 | 28 | 8 | 38 | 10 | 48 | 12 | 57 | 15 | 7 | 17 | 18 | 19 | 28 | 21 | 39 | 23 | 50 | 26 | 1 |
| 70 | 0 | 0 | 2 | 8 | 4 | 15 | 6 | 23 | 8 | 31 | 10 | 39 | 12 | 47 | 14 | 53 | 17 | 3 | 19 | 12 | 21 | 21 | 23 | 30 | 25 | 39 |

# TABLE XLVI.

## For finding the ALTITUDE of the Sun or a Star most advantageous for ascertaining the Apparent Time.

| Lat. | Declination of the same name with the Latitude. | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 26° | | 28° | | 30° | | 32° | | 34° | | 36° | | 38° | | 40° | | 42° | | 44° | | 46° | | 48° | | 50° | |
| ° | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ | ° | ′ |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 2 | 17 | 2 | 8 | 2 | 0 | 1 | 53 | 1 | 47 | 1 | 42 | 1 | 37 | 1 | 33 | 1 | 30 | 1 | 26 | 1 | 23 | 1 | 21 | 1 | 18 |
| 2 | 4 | 34 | 4 | 16 | 4 | 0 | 3 | 47 | 3 | 35 | 3 | 24 | 3 | 15 | 3 | 7 | 2 | 59 | 2 | 53 | 2 | 47 | 2 | 42 | 2 | 37 |
| 3 | 6 | 51 | 6 | 21 | 6 | 0 | 5 | 40 | 5 | 22 | 5 | 6 | 4 | 53 | 4 | 40 | 4 | 29 | 4 | 19 | 4 | 10 | 4 | 2 | 3 | 55 |
| 4 | 9 | 9 | 8 | 33 | 8 | 1 | 7 | 34 | 7 | 10 | 6 | 49 | 6 | 31 | 6 | 14 | 5 | 59 | 5 | 46 | 5 | 34 | 5 | 23 | 5 | 13 |
| 5 | 11 | 28 | 10 | 42 | 10 | 2 | 9 | 28 | 8 | 58 | 8 | 32 | 8 | 8 | 7 | 48 | 7 | 29 | 7 | 12 | 6 | 58 | 6 | 44 | 6 | 32 |
| 6 | 13 | 48 | 12 | 52 | 12 | 4 | 11 | 23 | 10 | 46 | 10 | 16 | 9 | 47 | 9 | 22 | 8 | 59 | 8 | 39 | 8 | 21 | 8 | 5 | 7 | 51 |
| 7 | 16 | 8 | 15 | 3 | 14 | 6 | 13 | 18 | 12 | 35 | 11 | 58 | 11 | 25 | 10 | 56 | 10 | 30 | 10 | 6 | 9 | 45 | 9 | 26 | 9 | 9 |
| 8 | 18 | 31 | 17 | 15 | 16 | 10 | 15 | 14 | 14 | 25 | 13 | 42 | 13 | 4 | 12 | 30 | 12 | 0 | 11 | 33 | 11 | 9 | 10 | 48 | 10 | 28 |
| 9 | 20 | 54 | 19 | 28 | 18 | 14 | 17 | 10 | 16 | 15 | 15 | 26 | 14 | 43 | 14 | 5 | 13 | 31 | 13 | 1 | 12 | 34 | 12 | 9 | 11 | 47 |
| 10 | 23 | 20 | 21 | 42 | 20 | 19 | 19 | 8 | 18 | 5 | 17 | 11 | 16 | 23 | 15 | 40 | 15 | 2 | 14 | 29 | 13 | 58 | 13 | 31 | 13 | 6 |
| 11 | 25 | 48 | 23 | 59 | 22 | 26 | 21 | 6 | 19 | 57 | 18 | 57 | 18 | 3 | 17 | 16 | 16 | 34 | 15 | 57 | 15 | 23 | 14 | 53 | 14 | 25 |
| 12 | 28 | 19 | 26 | 17 | 24 | 34 | 23 | 6 | 21 | 50 | 20 | 43 | 19 | 44 | 18 | 52 | 18 | 6 | 17 | 25 | 16 | 48 | 16 | 15 | 15 | 45 |
| 13 | 30 | 52 | 28 | 38 | 26 | 44 | 25 | 7 | 23 | 43 | 22 | 30 | 21 | 26 | 20 | 29 | 19 | 39 | 18 | 54 | 18 | 13 | 17 | 37 | 17 | 5 |
| 14 | 33 | 30 | 31 | 1 | 28 | 56 | 27 | 10 | 25 | 38 | 24 | 18 | 23 | 8 | 22 | 7 | 21 | 12 | 20 | 23 | 19 | 39 | 19 | 0 | 18 | 25 |
| 15 | 36 | 11 | 33 | 27 | 31 | 10 | 29 | 14 | 27 | 34 | 26 | 8 | 24 | 52 | 23 | 45 | 22 | 45 | 21 | 53 | 21 | 5 | 20 | 23 | 19 | 45 |
| 16 | 38 | 58 | 35 | 57 | 33 | 27 | 31 | 21 | 29 | 32 | 27 | 58 | 26 | 36 | 25 | 24 | 24 | 20 | 23 | 23 | 22 | 32 | 21 | 46 | 21 | 5 |
| 17 | 41 | 50 | 38 | 31 | 35 | 47 | 33 | 29 | 31 | 31 | 29 | 50 | 28 | 21 | 27 | 3 | 25 | 55 | 24 | 53 | 23 | 59 | 23 | 10 | 22 | 26 |
| 18 | 44 | 49 | 41 | 10 | 38 | 10 | 35 | 40 | 33 | 33 | 31 | 43 | 30 | 8 | 28 | 44 | 27 | 30 | 26 | 25 | 25 | 26 | 24 | 34 | 23 | 47 |
| 19 | 47 | 58 | 43 | 54 | 40 | 38 | 37 | 54 | 35 | 36 | 33 | 38 | 31 | 56 | 30 | 26 | 29 | 7 | 27 | 57 | 26 | 55 | 25 | 59 | 25 | 9 |
| 20 | 51 | 17 | 46 | 46 | 43 | 10 | 40 | 12 | 37 | 42 | 35 | 35 | 33 | 45 | 32 | 9 | 30 | 44 | 29 | 30 | 28 | 23 | 27 | 24 | 26 | 31 |
| 21 | 54 | 50 | 49 | 46 | 45 | 47 | 42 | 33 | 39 | 51 | 37 | 34 | 35 | 36 | 33 | 53 | 32 | 23 | 31 | 3 | 29 | 53 | 28 | 50 | 27 | 54 |
| 22 | 58 | 43 | 52 | 56 | 48 | 31 | 44 | 59 | 42 | 4 | 39 | 36 | 37 | 29 | 35 | 39 | 34 | 3 | 32 | 38 | 31 | 23 | 30 | 16 | 29 | 17 |
| 23 | 63 | 2 | 56 | 20 | 51 | 24 | 47 | 30 | 44 | 20 | 41 | 40 | 39 | 24 | 37 | 26 | 35 | 44 | 34 | 14 | 32 | 54 | 31 | 43 | 30 | 40 |
| 24 | 68 | 6 | 60 | 2 | 54 | 26 | 50 | 8 | 46 | 40 | 43 | 47 | 41 | 21 | 39 | 15 | 37 | 26 | 35 | 50 | 34 | 26 | 33 | 11 | 32 | 4 |
| 25 | 74 | 36 | 64 | 11 | 57 | 42 | 52 | 54 | 49 | 6 | 45 | 58 | 43 | 21 | 41 | 6 | 39 | 10 | 37 | 28 | 35 | 59 | 34 | 40 | 33 | 29 |
| 26 | 90 | 0 | 69 | 2 | 61 | 15 | 55 | 49 | 51 | 37 | 48 | 14 | 45 | 24 | 43 | 0 | 40 | 56 | 39 | 8 | 37 | 33 | 36 | 9 | 34 | 54 |
| 27 | 74 | 56 | 75 | 15 | 65 | 14 | 58 | 57 | 54 | 17 | 50 | 34 | 47 | 31 | 44 | 56 | 42 | 44 | 40 | 49 | 39 | 8 | 37 | 39 | 36 | 21 |
| 28 | 69 | 2 | 90 | 0 | 69 | 52 | 62 | 22 | 57 | 6 | 53 | 0 | 49 | 41 | 46 | 55 | 44 | 33 | 42 | 31 | 40 | 45 | 39 | 11 | 37 | 48 |
| 29 | 64 | 43 | 75 | 33 | 75 | 50 | 66 | 11 | 60 | 7 | 55 | 34 | 51 | 57 | 48 | 57 | 46 | 26 | 44 | 16 | 42 | 22 | 40 | 43 | 39 | 16 |
| 30 | 61 | 15 | 69 | 52 | 90 | 0 | 70 | 39 | 63 | 24 | 58 | 17 | 54 | 18 | 51 | 4 | 48 | 21 | 46 | 2 | 44 | 2 | 42 | 17 | 40 | 45 |
| 31 | 58 | 20 | 65 | 43 | 76 | 7 | 76 | 23 | 67 | 5 | 61 | 11 | 56 | 47 | 53 | 15 | 50 | 20 | 47 | 51 | 45 | 43 | 43 | 52 | 42 | 15 |
| 32 | 55 | 49 | 62 | 22 | 70 | 39 | 90 | 0 | 71 | 23 | 64 | 22 | 59 | 24 | 55 | 32 | 52 | 22 | 49 | 43 | 47 | 27 | 45 | 29 | 43 | 46 |
| 33 | 53 | 36 | 59 | 32 | 66 | 38 | 76 | 39 | 76 | 54 | 67 | 55 | 62 | 12 | 57 | 55 | 54 | 29 | 51 | 38 | 49 | 13 | 47 | 8 | 45 | 19 |
| 34 | 51 | 37 | 57 | 6 | 63 | 24 | 71 | 23 | 90 | 0 | 72 | 3 | 65 | 16 | 60 | 27 | 56 | 41 | 53 | 37 | 51 | 1 | 48 | 48 | 46 | 53 |
| 35 | 49 | 51 | 54 | 56 | 60 | 40 | 67 | 30 | 77 | 8 | 77 | 22 | 68 | 42 | 63 | 10 | 59 | 0 | 55 | 40 | 52 | 53 | 50 | 31 | 48 | 29 |
| 36 | 48 | 14 | 53 | 0 | 58 | 17 | 64 | 22 | 72 | 3 | 90 | 0 | 72 | 42 | 66 | 8 | 61 | 27 | 57 | 48 | 54 | 48 | 52 | 16 | 50 | 7 |
| 37 | 46 | 45 | 51 | 16 | 56 | 11 | 61 | 42 | 68 | 18 | 77 | 36 | 77 | 49 | 69 | 26 | 64 | 5 | 60 | 2 | 56 | 47 | 54 | 5 | 51 | 47 |
| 38 | 45 | 24 | 49 | 41 | 54 | 18 | 59 | 24 | 65 | 16 | 72 | 42 | 90 | 0 | 73 | 18 | 66 | 56 | 62 | 25 | 58 | 51 | 55 | 56 | 53 | 29 |
| 39 | 44 | 9 | 48 | 15 | 52 | 37 | 57 | 24 | 62 | 42 | 69 | 4 | 78 | 2 | 78 | 15 | 70 | 8 | 64 | 57 | 61 | 2 | 57 | 52 | 55 | 14 |
| 40 | 43 | 0 | 46 | 55 | 51 | 4 | 55 | 32 | 60 | 27 | 66 | 8 | 73 | 18 | 90 | 0 | 73 | 52 | 67 | 43 | 63 | 20 | 59 | 53 | 57 | 3 |
| 41 | 41 | 56 | 45 | 42 | 49 | 39 | 53 | 53 | 58 | 28 | 63 | 38 | 69 | 47 | 78 | 28 | 78 | 39 | 70 | 49 | 65 | 47 | 61 | 59 | 58 | 55 |
| 42 | 40 | 56 | 44 | 33 | 48 | 21 | 52 | 22 | 56 | 41 | 61 | 27 | 66 | 56 | 73 | 52 | 90 | 0 | 74 | 25 | 68 | 28 | 64 | 13 | 60 | 52 |
| 43 | 40 | 0 | 43 | 30 | 47 | 9 | 50 | 59 | 55 | 5 | 59 | 32 | 64 | 31 | 70 | 29 | 78 | 51 | 79 | 3 | 71 | 27 | 66 | 36 | 62 | 55 |
| 44 | 39 | 8 | 42 | 31 | 46 | 2 | 49 | 43 | 53 | 37 | 57 | 48 | 62 | 25 | 67 | 43 | 74 | 25 | 90 | 0 | 74 | 57 | 69 | 11 | 65 | 4 |
| 45 | 38 | 19 | 41 | 36 | 45 | 0 | 48 | 32 | 52 | 16 | 56 | 14 | 60 | 32 | 65 | 22 | 71 | 8 | 79 | 14 | 79 | 25 | 72 | 5 | 67 | 23 |
| 46 | 37 | 33 | 40 | 45 | 44 | 2 | 47 | 27 | 51 | 1 | 54 | 48 | 58 | 51 | 63 | 20 | 68 | 28 | 74 | 57 | 90 | 0 | 75 | 28 | 69 | 53 |
| 47 | 36 | 50 | 39 | 56 | 43 | 8 | 46 | 26 | 49 | 52 | 53 | 29 | 57 | 20 | 61 | 31 | 66 | 12 | 71 | 46 | 79 | 36 | 79 | 47 | 72 | 42 |
| 48 | 36 | 9 | 39 | 11 | 42 | 17 | 45 | 29 | 48 | 48 | 52 | 16 | 55 | 56 | 59 | 53 | 64 | 13 | 69 | 11 | 75 | 28 | 90 | 0 | 75 | 57 |
| 49 | 35 | 31 | 38 | 28 | 41 | 29 | 44 | 36 | 47 | 49 | 51 | 9 | 54 | 40 | 58 | 24 | 62 | 27 | 66 | 59 | 72 | 23 | 79 | 57 | 80 | 8 |
| 50 | 34 | 54 | 37 | 48 | 40 | 45 | 43 | 46 | 46 | 53 | 50 | 7 | 53 | 29 | 57 | 3 | 60 | 52 | 65 | 4 | 69 | 53 | 75 | 57 | 90 | 0 |
| 52 | 33 | 48 | 36 | 34 | 39 | 23 | 42 | 16 | 45 | 12 | 48 | 14 | 51 | 23 | 54 | 40 | 58 | 7 | 61 | 50 | 65 | 54 | 70 | 34 | 76 | 25 |
| 54 | 32 | 49 | 35 | 28 | 38 | 10 | 40 | 55 | 43 | 43 | 46 | 36 | 49 | 33 | 52 | 37 | 55 | 48 | 59 | 10 | 62 | 46 | 66 | 43 | 71 | 14 |
| 56 | 31 | 55 | 34 | 30 | 37 | 6 | 39 | 44 | 42 | 25 | 45 | 9 | 47 | 57 | 50 | 50 | 53 | 49 | 56 | 55 | 60 | 11 | 63 | 41 | 67 | 31 |
| 58 | 31 | 8 | 33 | 37 | 36 | 8 | 38 | 40 | 41 | 15 | 43 | 53 | 46 | 33 | 49 | 17 | 52 | 6 | 55 | 0 | 58 | 1 | 61 | 12 | 64 | 36 |
| 60 | 30 | 25 | 32 | 50 | 35 | 16 | 37 | 44 | 40 | 13 | 42 | 45 | 45 | 19 | 47 | 55 | 50 | 36 | 53 | 20 | 56 | 10 | 59 | 6 | 62 | 12 |
| 62 | 29 | 46 | 32 | 7 | 34 | 30 | 36 | 53 | 39 | 18 | 41 | 44 | 44 | 13 | 46 | 43 | 49 | 17 | 51 | 53 | 54 | 32 | 57 | 19 | 60 | 11 |
| 64 | 29 | 11 | 31 | 30 | 33 | 48 | 36 | 8 | 38 | 28 | 40 | 51 | 43 | 14 | 45 | 40 | 48 | 7 | 50 | 37 | 53 | 10 | 55 | 47 | 58 | 28 |
| 66 | 28 | 41 | 30 | 55 | 33 | 11 | 35 | 27 | 37 | 45 | 40 | 3 | 42 | 22 | 44 | 43 | 47 | 6 | 49 | 30 | 51 | 57 | 54 | 26 | 56 | 59 |
| 68 | 28 | 13 | 30 | 26 | 32 | 38 | 34 | 51 | 37 | 6 | 39 | 20 | 41 | 36 | 43 | 53 | 46 | 12 | 48 | 31 | 50 | 53 | 53 | 16 | 55 | 43 |
| 70 | 27 | 48 | 29 | 59 | 32 | 9 | 34 | 20 | 36 | 31 | 38 | 43 | 40 | 56 | 43 | 10 | 45 | 24 | 47 | 40 | 49 | 57 | 52 | 16 | 54 | 36 |

# TABLE XLVII.

**Logarithms for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.**

| Sec. or " | MINUTES OF AN HOUR OR A DEGREE. | | | | | | | | | | | | Sec. or " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 0 | | 1.7782 | 1.4771 | 1.3010 | 1.1761 | 1.0792 | 0000 | 9331 | 8751 | 8239 | 7782 | 7368 | 0 |
| 1 | 3.5563 | 1.7710 | 1.4735 | 1.2986 | 1.1743 | 1.0777 | 9988 | 9320 | 8742 | 8231 | 7774 | 7361 | 1 |
| 2 | 3.2553 | 1.7639 | 1.4699 | 1.2962 | 1.1725 | 1.0763 | 9976 | 9310 | 8733 | 8223 | 7767 | 7354 | 2 |
| 3 | 3.0792 | 1.7570 | 1.4664 | 1.2939 | 1.1707 | 1.0749 | 9964 | 9300 | 8724 | 8215 | 7760 | 7348 | 3 |
| 4 | 2.9542 | 1.7501 | 1.4629 | 1.2915 | 1.1689 | 1.0734 | 9952 | 9289 | 8715 | 8207 | 7753 | 7341 | 4 |
| 5 | 2.8573 | 1.7434 | 1.4594 | 1.2891 | 1.1671 | 1.0720 | 9940 | 9279 | 8706 | 8199 | 7745 | 7335 | 5 |
| 6 | 2.7782 | 1.7368 | 1.4559 | 1.2868 | 1.1654 | 1.0706 | 9928 | 9269 | 8697 | 8191 | 7738 | 7328 | 6 |
| 7 | 2.7112 | 1.7302 | 1.4525 | 1.2845 | 1.1636 | 1.0692 | 9916 | 9259 | 8688 | 8183 | 7731 | 7322 | 7 |
| 8 | 2.6532 | 1.7238 | 1.4491 | 1.2821 | 1.1619 | 1.0678 | 9905 | 9249 | 8679 | 8175 | 7724 | 7315 | 8 |
| 9 | 2.6021 | 1.7175 | 1.4457 | 1.2798 | 1.1601 | 1.0663 | 9893 | 9238 | 8670 | 8167 | 7717 | 7309 | 9 |
| 10 | 2.5563 | 1.7112 | 1.4424 | 1.2775 | 1.1584 | 1.0649 | 9881 | 9228 | 8661 | 8159 | 7710 | 7302 | 10 |
| 11 | 2.5149 | 1.7050 | 1.4390 | 1.2753 | 1.1566 | 1.0635 | 9869 | 9218 | 8652 | 8152 | 7703 | 7296 | 11 |
| 12 | 2.4771 | 1.6990 | 1.4357 | 1.2730 | 1.1549 | 1.0621 | 9858 | 9208 | 8643 | 8144 | 7696 | 7289 | 12 |
| 13 | 2.4424 | 1.6930 | 1.4325 | 1.2707 | 1.1532 | 1.0608 | 9846 | 9198 | 8635 | 8136 | 7688 | 7283 | 13 |
| 14 | 2.4102 | 1.6871 | 1.4292 | 1.2685 | 1.1515 | 1.0594 | 9834 | 9188 | 8626 | 8128 | 7681 | 7276 | 14 |
| 15 | 2.3802 | 1.6812 | 1.4260 | 1.2663 | 1.1498 | 1.0580 | 9823 | 9178 | 8617 | 8120 | 7674 | 7270 | 15 |
| 16 | 2.3522 | 1.6755 | 1.4228 | 1.2640 | 1.1481 | 1.0566 | 9811 | 9168 | 8608 | 8112 | 7667 | 7264 | 16 |
| 17 | 2.3259 | 1.6698 | 1.4196 | 1.2618 | 1.1464 | 1.0552 | 9800 | 9158 | 8599 | 8104 | 7660 | 7257 | 17 |
| 18 | 2.3010 | 1.6642 | 1.4165 | 1.2596 | 1.1447 | 1.0539 | 9788 | 9148 | 8591 | 8097 | 7653 | 7251 | 18 |
| 19 | 2.2775 | 1.6587 | 1.4133 | 1.2574 | 1.1430 | 1.0525 | 9777 | 9138 | 8582 | 8089 | 7646 | 7244 | 19 |
| 20 | 2.2553 | 1.6532 | 1.4102 | 1.2553 | 1.1413 | 1.0512 | 9765 | 9128 | 8573 | 8081 | 7639 | 7238 | 20 |
| 21 | 2.2341 | 1.6478 | 1.4071 | 1.2531 | 1.1397 | 1.0498 | 9754 | 9119 | 8565 | 8073 | 7632 | 7232 | 21 |
| 22 | 2.2139 | 1.6425 | 1.4040 | 1.2510 | 1.1380 | 1.0484 | 9742 | 9109 | 8556 | 8066 | 7625 | 7225 | 22 |
| 23 | 2.1946 | 1.6372 | 1.4010 | 1.2488 | 1.1363 | 1.0471 | 9731 | 9099 | 8547 | 8058 | 7618 | 7219 | 23 |
| 24 | 2.1761 | 1.6320 | 1.3979 | 1.2467 | 1.1347 | 1.0458 | 9720 | 9089 | 8539 | 8050 | 7611 | 7212 | 24 |
| 25 | 2.1584 | 1.6269 | 1.3949 | 1.2445 | 1.1331 | 1.0444 | 9708 | 9079 | 8530 | 8043 | 7604 | 7206 | 25 |
| 26 | 2.1413 | 1.6218 | 1.3919 | 1.2424 | 1.1314 | 1.0431 | 9697 | 9070 | 8522 | 8035 | 7597 | 7200 | 26 |
| 27 | 2.1249 | 1.6168 | 1.3890 | 1.2403 | 1.1298 | 1.0418 | 9686 | 9060 | 8513 | 8027 | 7590 | 7193 | 27 |
| 28 | 2.1091 | 1.6118 | 1.3860 | 1.2382 | 1.1282 | 1.0404 | 9675 | 9050 | 8504 | 8020 | 7583 | 7187 | 28 |
| 29 | 2.0939 | 1.6069 | 1.3831 | 1.2362 | 1.1266 | 1.0391 | 9664 | 9041 | 8496 | 8012 | 7577 | 7181 | 29 |
| 30 | 2.0792 | 1.6021 | 1.3802 | 1.2341 | 1.1249 | 1.0378 | 9652 | 9031 | 8487 | 8004 | 7570 | 7175 | 30 |
| 31 | 2.0649 | 1.5973 | 1.3773 | 1.2320 | 1.1233 | 1.0365 | 9641 | 9021 | 8479 | 7997 | 7563 | 7168 | 31 |
| 32 | 2.0512 | 1.5925 | 1.3745 | 1.2300 | 1.1217 | 1.0352 | 9630 | 9012 | 8470 | 7989 | 7556 | 7162 | 32 |
| 33 | 2.0378 | 1.5878 | 1.3716 | 1.2279 | 1.1201 | 1.0339 | 9619 | 9002 | 8462 | 7981 | 7549 | 7156 | 33 |
| 34 | 2.0248 | 1.5832 | 1.3688 | 1.2259 | 1.1186 | 1.0326 | 9608 | 8992 | 8453 | 7974 | 7542 | 7149 | 34 |
| 35 | 2.0122 | 1.5786 | 1.3660 | 1.2239 | 1.1170 | 1.0313 | 9597 | 8983 | 8445 | 7966 | 7535 | 7143 | 35 |
| 36 | 2.0000 | 1.5740 | 1.3632 | 1.2218 | 1.1154 | 1.0300 | 9586 | 8973 | 8437 | 7959 | 7528 | 7137 | 36 |
| 37 | 1.9881 | 1.5695 | 1.3604 | 1.2198 | 1.1138 | 1.0287 | 9575 | 8964 | 8428 | 7951 | 7522 | 7131 | 37 |
| 38 | 1.9765 | 1.5651 | 1.3576 | 1.2178 | 1.1123 | 1.0274 | 9564 | 8954 | 8420 | 7944 | 7515 | 7124 | 38 |
| 39 | 1.9652 | 1.5607 | 1.3549 | 1.2159 | 1.1107 | 1.0261 | 9553 | 8945 | 8411 | 7936 | 7508 | 7118 | 39 |
| 40 | 1.9542 | 1.5563 | 1.3522 | 1.2139 | 1.1091 | 1.0248 | 9542 | 8935 | 8403 | 7929 | 7501 | 7112 | 40 |
| 41 | 1.9435 | 1.5520 | 1.3495 | 1.2119 | 1.1076 | 1.0235 | 9532 | 8926 | 8395 | 7921 | 7494 | 7106 | 41 |
| 42 | 1.9331 | 1.5477 | 1.3468 | 1.2099 | 1.1061 | 1.0223 | 9521 | 8917 | 8386 | 7914 | 7488 | 7100 | 42 |
| 43 | 1.9228 | 1.5435 | 1.3441 | 1.2080 | 1.1045 | 1.0210 | 9510 | 8907 | 8378 | 7906 | 7481 | 7093 | 43 |
| 44 | 1.9128 | 1.5393 | 1.3415 | 1.2061 | 1.1030 | 1.0197 | 9499 | 8898 | 8370 | 7899 | 7474 | 7087 | 44 |
| 45 | 1.9031 | 1.5351 | 1.3388 | 1.2041 | 1.1015 | 1.0185 | 9488 | 8888 | 8361 | 7891 | 7467 | 7081 | 45 |
| 46 | 1.8935 | 1.5310 | 1.3362 | 1.2022 | 1.0999 | 1.0172 | 9478 | 8879 | 8353 | 7884 | 7461 | 7075 | 46 |
| 47 | 1.8842 | 1.5269 | 1.3336 | 1.2003 | 1.0984 | 1.0160 | 9467 | 8870 | 8345 | 7877 | 7454 | 7069 | 47 |
| 48 | 1.8751 | 1.5229 | 1.3310 | 1.1984 | 1.0969 | 1.0147 | 9456 | 8861 | 8337 | 7869 | 7447 | 7063 | 48 |
| 49 | 1.8661 | 1.5189 | 1.3284 | 1.1965 | 1.0954 | 1.0135 | 9446 | 8851 | 8328 | 7862 | 7441 | 7057 | 49 |
| 50 | 1.8573 | 1.5149 | 1.3259 | 1.1946 | 1.0939 | 1.0122 | 9435 | 8842 | 8320 | 7855 | 7434 | 7050 | 50 |
| 51 | 1.8487 | 1.5110 | 1.3233 | 1.1927 | 1.0924 | 1.0110 | 9425 | 8833 | 8312 | 7847 | 7427 | 7044 | 51 |
| 52 | 1.8403 | 1.5071 | 1.3208 | 1.1908 | 1.0909 | 1.0098 | 9414 | 8824 | 8304 | 7840 | 7421 | 7038 | 52 |
| 53 | 1.8320 | 1.5032 | 1.3183 | 1.1889 | 1.0894 | 1.0085 | 9404 | 8814 | 8296 | 7832 | 7414 | 7032 | 53 |
| 54 | 1.8239 | 1.4994 | 1.3158 | 1.1871 | 1.0880 | 1.0073 | 9393 | 8805 | 8288 | 7825 | 7407 | 7026 | 54 |
| 55 | 1.8159 | 1.4956 | 1.3133 | 1.1852 | 1.0865 | 1.0061 | 9383 | 8796 | 8279 | 7818 | 7401 | 7020 | 55 |
| 56 | 1.8081 | 1.4918 | 1.3108 | 1.1834 | 1.0850 | 1.0049 | 9372 | 8787 | 8271 | 7811 | 7394 | 7014 | 56 |
| 57 | 1.8004 | 1.4881 | 1.3083 | 1.1816 | 1.0835 | 1.0036 | 9362 | 8778 | 8263 | 7803 | 7387 | 7008 | 57 |
| 58 | 1.7929 | 1.4844 | 1.3059 | 1.1797 | 1.0821 | 1.0024 | 9351 | 8769 | 8255 | 7796 | 7381 | 7002 | 58 |
| 59 | 1.7855 | 1.4808 | 1.3034 | 1.1779 | 1.0806 | 1.0012 | 9341 | 8760 | 8247 | 7789 | 7374 | 6996 | 59 |
| 60 | 1.7782 | 1.4771 | 1.3010 | 1.1761 | 1.0792 | 1.0000 | 9331 | 8751 | 8239 | 7782 | 7368 | 6990 | 60 |

1.7855
1.7782

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**Logarithms for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.**

| Sec. or " | MINUTES OF AN HOUR OR A DEGREE. | | | | | | | | | | | | Sec. or " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | |
| 0 | 6990 | 6642 | 6320 | 6021 | 5740 | 5477 | 5229 | 4994 | 4771 | 4559 | 4357 | 4164 | 0 |
| 1 | 6984 | 6637 | 6315 | 6016 | 5736 | 5473 | 5225 | 4990 | 4768 | 4556 | 4354 | 4161 | 1 |
| 2 | 6978 | 6631 | 6310 | 6011 | 5731 | 5469 | 5221 | 4986 | 4764 | 4552 | 4351 | 4158 | 2 |
| 3 | 6972 | 6625 | 6305 | 6006 | 5727 | 5464 | 5217 | 4983 | 4760 | 4549 | 4347 | 4155 | 3 |
| 4 | 6966 | 6620 | 6300 | 6001 | 5722 | 5460 | 5213 | 4979 | 4757 | 4546 | 4344 | 4152 | 4 |
| 5 | 6960 | 6614 | 6294 | 5997 | 5718 | 5456 | 5209 | 4975 | 4753 | 4542 | 4341 | 4149 | 5 |
| 6 | 6954 | 6609 | 6289 | 5992 | 5713 | 5452 | 5205 | 4971 | 4750 | 4539 | 4338 | 4145 | 6 |
| 7 | 6948 | 6603 | 6284 | 5987 | 5709 | 5447 | 5201 | 4967 | 4746 | 4535 | 4334 | 4142 | 7 |
| 8 | 6942 | 6598 | 6279 | 5982 | 5704 | 5443 | 5197 | 4964 | 4742 | 4532 | 4331 | 4139 | 8 |
| 9 | 6936 | 6592 | 6274 | 5977 | 5700 | 5439 | 5193 | 4960 | 4739 | 4528 | 4328 | 4136 | 9 |
| 10 | 6930 | 6587 | 6269 | 5973 | 5695 | 5435 | 5189 | 4956 | 4735 | 4525 | 4325 | 4133 | 10 |
| 11 | 6924 | 6581 | 6264 | 5968 | 5691 | 5430 | 5185 | 4952 | 4732 | 4522 | 4321 | 4130 | 11 |
| 12 | 6918 | 6576 | 6259 | 5963 | 5686 | 5426 | 5181 | 4949 | 4728 | 4518 | 4318 | 4127 | 12 |
| 13 | 6912 | 6570 | 6254 | 5958 | 5682 | 5422 | 5177 | 4945 | 4724 | 4515 | 4315 | 4124 | 13 |
| 14 | 6906 | 6565 | 6248 | 5954 | 5677 | 5418 | 5173 | 4941 | 4721 | 4511 | 4311 | 4120 | 14 |
| 15 | 6900 | 6559 | 6243 | 5949 | 5673 | 5414 | 5169 | 4937 | 4717 | 4508 | 4308 | 4117 | 15 |
| 16 | 6894 | 6554 | 6238 | 5944 | 5669 | 5409 | 5165 | 4933 | 4714 | 4505 | 4305 | 4114 | 16 |
| 17 | 6888 | 6548 | 6233 | 5939 | 5664 | 5405 | 5161 | 4930 | 4710 | 4501 | 4302 | 4111 | 17 |
| 18 | 6882 | 6543 | 6228 | 5935 | 5660 | 5401 | 5157 | 4926 | 4707 | 4498 | 4298 | 4108 | 18 |
| 19 | 6877 | 6538 | 6223 | 5930 | 5655 | 5397 | 5153 | 4922 | 4703 | 4494 | 4295 | 4105 | 19 |
| 20 | 6871 | 6532 | 6218 | 5925 | 5651 | 5393 | 5149 | 4918 | 4699 | 4491 | 4292 | 4102 | 20 |
| 21 | 6865 | 6527 | 6213 | 5920 | 5646 | 5389 | 5145 | 4915 | 4696 | 4488 | 4289 | 4099 | 21 |
| 22 | 6859 | 6521 | 6208 | 5916 | 5642 | 5384 | 5141 | 4911 | 4692 | 4484 | 4285 | 4096 | 22 |
| 23 | 6853 | 6516 | 6203 | 5911 | 5637 | 5380 | 5137 | 4907 | 4689 | 4481 | 4282 | 4092 | 23 |
| 24 | 6847 | 6510 | 6198 | 5906 | 5633 | 5376 | 5133 | 4903 | 4685 | 4477 | 4279 | 4089 | 24 |
| 25 | 6841 | 6505 | 6193 | 5902 | 5629 | 5372 | 5129 | 4900 | 4682 | 4474 | 4276 | 4086 | 25 |
| 26 | 6836 | 6500 | 6188 | 5897 | 5624 | 5368 | 5125 | 4896 | 4678 | 4471 | 4273 | 4083 | 26 |
| 27 | 6830 | 6494 | 6183 | 5892 | 5620 | 5364 | 5122 | 4892 | 4675 | 4467 | 4269 | 4080 | 27 |
| 28 | 6824 | 6489 | 6178 | 5888 | 5615 | 5359 | 5118 | 4889 | 4671 | 4464 | 4266 | 4077 | 28 |
| 29 | 6818 | 6484 | 6173 | 5883 | 5611 | 5355 | 5114 | 4885 | 4668 | 4460 | 4263 | 4074 | 29 |
| 30 | 6812 | 6478 | 6168 | 5878 | 5607 | 5351 | 5110 | 4881 | 4664 | 4457 | 4260 | 4071 | 30 |
| 31 | 6807 | 6473 | 6163 | 5874 | 5602 | 5347 | 5106 | 4877 | 4660 | 4454 | 4256 | 4068 | 31 |
| 32 | 6801 | 6467 | 6158 | 5869 | 5598 | 5343 | 5102 | 4874 | 4657 | 4450 | 4253 | 4065 | 32 |
| 33 | 6795 | 6462 | 6153 | 5864 | 5594 | 5339 | 5098 | 4870 | 4653 | 4447 | 4250 | 4062 | 33 |
| 34 | 6789 | 6457 | 6148 | 5860 | 5589 | 5335 | 5094 | 4866 | 4650 | 4444 | 4247 | 4059 | 34 |
| 35 | 6784 | 6451 | 6143 | 5855 | 5585 | 5331 | 5090 | 4863 | 4646 | 4440 | 4244 | 4055 | 35 |
| 36 | 6778 | 6446 | 6138 | 5850 | 5580 | 5326 | 5086 | 4859 | 4643 | 4437 | 4240 | 4052 | 36 |
| 37 | 6772 | 6441 | 6133 | 5846 | 5576 | 5322 | 5082 | 4855 | 4639 | 4434 | 4237 | 4049 | 37 |
| 38 | 6766 | 6435 | 6128 | 5841 | 5572 | 5318 | 5079 | 4852 | 4636 | 4430 | 4234 | 4046 | 38 |
| 39 | 6761 | 6430 | 6123 | 5836 | 5567 | 5314 | 5075 | 4848 | 4632 | 4427 | 4231 | 4043 | 39 |
| 40 | 6755 | 6425 | 6118 | 5832 | 5563 | 5310 | 5071 | 4844 | 4629 | 4424 | 4228 | 4040 | 40 |
| 41 | 6749 | 6420 | 6113 | 5827 | 5559 | 5306 | 5067 | 4841 | 4625 | 4420 | 4224 | 4037 | 41 |
| 42 | 6743 | 6414 | 6108 | 5823 | 5554 | 5302 | 5063 | 4837 | 4622 | 4417 | 4221 | 4034 | 42 |
| 43 | 6738 | 6409 | 6103 | 5818 | 5550 | 5298 | 5059 | 4833 | 4618 | 4414 | 4218 | 4031 | 43 |
| 44 | 6732 | 6404 | 6099 | 5813 | 5546 | 5294 | 5055 | 4830 | 4615 | 4410 | 4215 | 4028 | 44 |
| 45 | 6726 | 6398 | 6094 | 5809 | 5541 | 5290 | 5051 | 4826 | 4611 | 4407 | 4212 | 4025 | 45 |
| 46 | 6721 | 6393 | 6089 | 5804 | 5537 | 5285 | 5048 | 4822 | 4608 | 4404 | 4209 | 4022 | 46 |
| 47 | 6715 | 6388 | 6084 | 5800 | 5533 | 5281 | 5044 | 4819 | 4604 | 4400 | 4205 | 4019 | 47 |
| 48 | 6709 | 6383 | 6079 | 5795 | 5528 | 5277 | 5040 | 4815 | 4601 | 4397 | 4202 | 4016 | 48 |
| 49 | 6704 | 6377 | 6074 | 5790 | 5524 | 5273 | 5036 | 4811 | 4597 | 4394 | 4199 | 4013 | 49 |
| 50 | 6698 | 6372 | 6069 | 5786 | 5520 | 5269 | 5032 | 4808 | 4594 | 4390 | 4196 | 4010 | 50 |
| 51 | 6692 | 6367 | 6064 | 5781 | 5516 | 5265 | 5028 | 4804 | 4590 | 4387 | 4193 | 4007 | 51 |
| 52 | 6687 | 6362 | 6059 | 5777 | 5511 | 5261 | 5025 | 4800 | 4587 | 4384 | 4189 | 4004 | 52 |
| 53 | 6681 | 6357 | 6055 | 5772 | 5507 | 5257 | 5021 | 4797 | 4584 | 4380 | 4186 | 4001 | 53 |
| 54 | 6676 | 6351 | 6050 | 5768 | 5503 | 5253 | 5017 | 4793 | 4580 | 4377 | 4183 | 3998 | 54 |
| 55 | 6670 | 6346 | 6045 | 5763 | 5498 | 5249 | 5013 | 4789 | 4577 | 4374 | 4180 | 3995 | 55 |
| 56 | 6664 | 6341 | 6040 | 5758 | 5494 | 5245 | 5009 | 4786 | 4573 | 4370 | 4177 | 3991 | 56 |
| 57 | 6659 | 6336 | 6035 | 5754 | 5490 | 5241 | 5005 | 4782 | 4570 | 4367 | 4174 | 3988 | 57 |
| 58 | 6653 | 6331 | 6030 | 5749 | 5486 | 5237 | 5002 | 4778 | 4566 | 4364 | 4171 | 3985 | 58 |
| 59 | 6648 | 6325 | 6025 | 5745 | 5481 | 5233 | 4998 | 4775 | 4563 | 4361 | 4167 | 3982 | 59 |
| 60 | 6642 | 6320 | 6021 | 5740 | 5477 | 5229 | 4994 | 4771 | 4559 | 4357 | 4164 | 3979 | 60 |

# TABLE XLVII.

LOGARITHMS for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.

| Sec. or " | MINUTES OF AN HOUR OR A DEGREE. | | | | | | | | | | | | Sec. or " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | |
| 0 | 3979 | 3802 | 3632 | 3468 | 3310 | 3158 | 3010 | 2868 | 2730 | 2596 | 2467 | 2341 | 0 |
| 1 | 3976 | 3799 | 3629 | 3465 | 3307 | 3155 | 3008 | 2866 | 2728 | 2594 | 2465 | 2339 | 1 |
| 2 | 3973 | 3796 | 3626 | 3463 | 3305 | 3153 | 3005 | 2863 | 2725 | 2592 | 2462 | 2337 | 2 |
| 3 | 3970 | 3793 | 3623 | 3460 | 3302 | 3150 | 3003 | 2861 | 2723 | 2590 | 2460 | 2335 | 3 |
| 4 | 3967 | 3791 | 3621 | 3457 | 3300 | 3148 | 3001 | 2859 | 2721 | 2588 | 2458 | 2333 | 4 |
| 5 | 3964 | 3788 | 3618 | 3454 | 3297 | 3145 | 2998 | 2856 | 2719 | 2585 | 2456 | 2331 | 5 |
| 6 | 3961 | 3785 | 3615 | 3452 | 3294 | 3143 | 2996 | 2854 | 2716 | 2583 | 2454 | 2328 | 6 |
| 7 | 3958 | 3782 | 3612 | 3449 | 3292 | 3140 | 2993 | 2852 | 2714 | 2581 | 2452 | 2326 | 7 |
| 8 | 3955 | 3779 | 3610 | 3446 | 3289 | 3138 | 2991 | 2849 | 2712 | 2579 | 2450 | 2324 | 8 |
| 9 | 3952 | 3776 | 3607 | 3444 | 3287 | 3135 | 2989 | 2847 | 2710 | 2577 | 2448 | 2322 | 9 |
| 10 | 3949 | 3773 | 3604 | 3441 | 3284 | 3133 | 2986 | 2845 | 2707 | 2574 | 2445 | 2320 | 10 |
| 11 | 3946 | 3770 | 3601 | 3438 | 3282 | 3130 | 2984 | 2842 | 2705 | 2572 | 2443 | 2318 | 11 |
| 12 | 3943 | 3768 | 3598 | 3436 | 3279 | 3128 | 2981 | 2840 | 2703 | 2570 | 2441 | 2316 | 12 |
| 13 | 3940 | 3765 | 3596 | 3433 | 3276 | 3125 | 2979 | 2838 | 2701 | 2568 | 2439 | 2314 | 13 |
| 14 | 3937 | 3762 | 3593 | 3431 | 3274 | 3123 | 2977 | 2835 | 2698 | 2566 | 2437 | 2312 | 14 |
| 15 | 3934 | 3759 | 3590 | 3428 | 3271 | 3120 | 2974 | 2833 | 2696 | 2564 | 2435 | 2310 | 15 |
| 16 | 3931 | 3756 | 3587 | 3425 | 3269 | 3118 | 2972 | 2831 | 2694 | 2561 | 2433 | 2308 | 16 |
| 17 | 3928 | 3753 | 3585 | 3423 | 3266 | 3115 | 2969 | 2828 | 2692 | 2559 | 2431 | 2306 | 17 |
| 18 | 3925 | 3750 | 3582 | 3420 | 3264 | 3113 | 2967 | 2826 | 2689 | 2557 | 2429 | 2304 | 18 |
| 19 | 3922 | 3747 | 3579 | 3417 | 3261 | 3110 | 2965 | 2824 | 2687 | 2555 | 2426 | 2302 | 19 |
| 20 | 3919 | 3745 | 3576 | 3415 | 3259 | 3108 | 2962 | 2821 | 2685 | 2553 | 2424 | 2300 | 20 |
| 21 | 3917 | 3742 | 3574 | 3412 | 3256 | 3105 | 2960 | 2819 | 2683 | 2551 | 2422 | 2298 | 21 |
| 22 | 3914 | 3739 | 3571 | 3409 | 3253 | 3103 | 2958 | 2817 | 2681 | 2548 | 2420 | 2296 | 22 |
| 23 | 3911 | 3736 | 3568 | 3407 | 3251 | 3101 | 2955 | 2815 | 2678 | 2546 | 2418 | 2294 | 23 |
| 24 | 3908 | 3733 | 3565 | 3404 | 3248 | 3098 | 2953 | 2812 | 2676 | 2544 | 2416 | 2291 | 24 |
| 25 | 3905 | 3730 | 3563 | 3401 | 3246 | 3096 | 2950 | 2810 | 2674 | 2542 | 2414 | 2289 | 25 |
| 26 | 3902 | 3727 | 3560 | 3399 | 3243 | 3093 | 2948 | 2808 | 2672 | 2540 | 2412 | 2287 | 26 |
| 27 | 3899 | 3725 | 3557 | 3396 | 3241 | 3091 | 2946 | 2805 | 2669 | 2538 | 2410 | 2285 | 27 |
| 28 | 3896 | 3722 | 3555 | 3393 | 3238 | 3088 | 2943 | 2803 | 2667 | 2535 | 2408 | 2283 | 28 |
| 29 | 3893 | 3719 | 3552 | 3391 | 3236 | 3086 | 2941 | 2801 | 2665 | 2533 | 2405 | 2281 | 29 |
| 30 | 3890 | 3716 | 3549 | 3388 | 3233 | 3083 | 2939 | 2798 | 2663 | 2531 | 2403 | 2279 | 30 |
| 31 | 3887 | 3713 | 3546 | 3386 | 3231 | 3081 | 2936 | 2796 | 2660 | 2529 | 2401 | 2277 | 31 |
| 32 | 3884 | 3710 | 3544 | 3383 | 3228 | 3078 | 2934 | 2794 | 2658 | 2527 | 2399 | 2275 | 32 |
| 33 | 3881 | 3708 | 3541 | 3380 | 3225 | 3076 | 2931 | 2792 | 2656 | 2525 | 2397 | 2273 | 33 |
| 34 | 3878 | 3705 | 3538 | 3378 | 3223 | 3073 | 2929 | 2789 | 2654 | 2522 | 2395 | 2271 | 34 |
| 35 | 3875 | 3702 | 3535 | 3375 | 3220 | 3071 | 2927 | 2787 | 2652 | 2520 | 2393 | 2269 | 35 |
| 36 | 3872 | 3699 | 3533 | 3372 | 3218 | 3069 | 2924 | 2785 | 2649 | 2518 | 2391 | 2267 | 36 |
| 37 | 3869 | 3696 | 3530 | 3370 | 3215 | 3066 | 2922 | 2782 | 2647 | 2516 | 2389 | 2265 | 37 |
| 38 | 3866 | 3693 | 3527 | 3367 | 3213 | 3064 | 2920 | 2780 | 2645 | 2514 | 2387 | 2263 | 38 |
| 39 | 3863 | 3691 | 3525 | 3365 | 3210 | 3061 | 2917 | 2778 | 2643 | 2512 | 2384 | 2261 | 39 |
| 40 | 3860 | 3688 | 3522 | 3362 | 3208 | 3059 | 2915 | 2775 | 2640 | 2510 | 2382 | 2259 | 40 |
| 41 | 3857 | 3685 | 3519 | 3359 | 3205 | 3056 | 2912 | 2773 | 2638 | 2507 | 2380 | 2257 | 41 |
| 42 | 3855 | 3682 | 3516 | 3357 | 3203 | 3054 | 2910 | 2771 | 2636 | 2505 | 2378 | 2255 | 42 |
| 43 | 3852 | 3679 | 3514 | 3354 | 3200 | 3052 | 2908 | 2769 | 2634 | 2503 | 2376 | 2253 | 43 |
| 44 | 3849 | 3677 | 3511 | 3351 | 3198 | 3049 | 2905 | 2766 | 2632 | 2501 | 2374 | 2251 | 44 |
| 45 | 3846 | 3674 | 3508 | 3349 | 3195 | 3047 | 2903 | 2764 | 2629 | 2499 | 2372 | 2249 | 45 |
| 46 | 3843 | 3671 | 3506 | 3346 | 3193 | 3044 | 2901 | 2762 | 2627 | 2497 | 2370 | 2247 | 46 |
| 47 | 3840 | 3668 | 3503 | 3344 | 3190 | 3042 | 2898 | 2760 | 2625 | 2494 | 2368 | 2245 | 47 |
| 48 | 3837 | 3665 | 3500 | 3341 | 3188 | 3039 | 2896 | 2757 | 2623 | 2492 | 2366 | 2243 | 48 |
| 49 | 3834 | 3663 | 3497 | 3338 | 3185 | 3037 | 2894 | 2755 | 2621 | 2490 | 2364 | 2241 | 49 |
| 50 | 3831 | 3660 | 3495 | 3336 | 3183 | 3034 | 2891 | 2753 | 2618 | 2488 | 2362 | 2239 | 50 |
| 51 | 3828 | 3657 | 3492 | 3333 | 3180 | 3032 | 2889 | 2750 | 2616 | 2486 | 2359 | 2237 | 51 |
| 52 | 3825 | 3654 | 3489 | 3331 | 3178 | 3030 | 2887 | 2748 | 2614 | 2484 | 2357 | 2235 | 52 |
| 53 | 3822 | 3651 | 3487 | 3328 | 3175 | 3027 | 2884 | 2746 | 2612 | 2482 | 2355 | 2233 | 53 |
| 54 | 3820 | 3649 | 3484 | 3325 | 3173 | 3025 | 2882 | 2744 | 2610 | 2480 | 2353 | 2231 | 54 |
| 55 | 3817 | 3646 | 3481 | 3323 | 3170 | 3022 | 2880 | 2741 | 2607 | 2477 | 2351 | 2229 | 55 |
| 56 | 3814 | 3643 | 3479 | 3320 | 3168 | 3020 | 2877 | 2739 | 2605 | 2475 | 2349 | 2227 | 56 |
| 57 | 3811 | 3640 | 3476 | 3318 | 3165 | 3018 | 2875 | 2737 | 2603 | 2473 | 2347 | 2225 | 57 |
| 58 | 3808 | 3637 | 3473 | 3315 | 3163 | 3015 | 2873 | 2735 | 2601 | 2471 | 2345 | 2223 | 58 |
| 59 | 3805 | 3635 | 3471 | 3313 | 3160 | 3013 | 2870 | 2732 | 2599 | 2469 | 2343 | 2220 | 59 |
| 60 | 3802 | 3632 | 3468 | 3310 | 3158 | 3010 | 2868 | 2730 | 2596 | 2467 | 2341 | 2218 | 60 |

LOGARITHMS for finding the Correction to reduce the MOON'S Declination or Right Ascension to any Time under the Meridian of Greenwich.

| Sec. or " | MINUTES OF AN HOUR OR A DEGREE. | | | | | | | | | | | | Sec. or " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | |
| 0 | 2218 | 2099 | 1984 | 1871 | 1761 | 1654 | 1549 | 1447 | 1347 | 1249 | 1154 | 1061 | 0 |
| 1 | 2216 | 2098 | 1982 | 1869 | 1759 | 1652 | 1547 | 1445 | 1345 | 1248 | 1152 | 1059 | 1 |
| 2 | 2214 | 2096 | 1980 | 1867 | 1757 | 1650 | 1546 | 1443 | 1344 | 1246 | 1151 | 1057 | 2 |
| 3 | 2212 | 2094 | 1978 | 1865 | 1755 | 1648 | 1544 | 1442 | 1342 | 1245 | 1149 | 1056 | 3 |
| 4 | 2210 | 2092 | 1976 | 1863 | 1754 | 1647 | 1542 | 1440 | 1340 | 1243 | 1148 | 1054 | 4 |
| 5 | 2208 | 2090 | 1974 | 1862 | 1752 | 1645 | 1540 | 1438 | 1339 | 1241 | 1146 | 1053 | 5 |
| 6 | 2206 | 2088 | 1972 | 1860 | 1750 | 1643 | 1539 | 1437 | 1337 | 1240 | 1145 | 1051 | 6 |
| 7 | 2204 | 2086 | 1970 | 1858 | 1748 | 1641 | 1537 | 1435 | 1335 | 1238 | 1143 | 1050 | 7 |
| 8 | 2202 | 2084 | 1968 | 1856 | 1746 | 1640 | 1535 | 1433 | 1334 | 1237 | 1141 | 1048 | 8 |
| 9 | 2200 | 2082 | 1967 | 1854 | 1745 | 1638 | 1534 | 1432 | 1332 | 1235 | 1140 | 1047 | 9 |
| 10 | 2198 | 2080 | 1965 | 1852 | 1743 | 1636 | 1532 | 1430 | 1331 | 1233 | 1138 | 1045 | 10 |
| 11 | 2196 | 2078 | 1963 | 1850 | 1741 | 1634 | 1530 | 1428 | 1329 | 1232 | 1137 | 1044 | 11 |
| 12 | 2194 | 2076 | 1961 | 1849 | 1739 | 1633 | 1528 | 1427 | 1327 | 1230 | 1135 | 1042 | 12 |
| 13 | 2192 | 2074 | 1959 | 1847 | 1737 | 1631 | 1527 | 1425 | 1326 | 1229 | 1134 | 1041 | 13 |
| 14 | 2190 | 2072 | 1957 | 1845 | 1736 | 1629 | 1525 | 1423 | 1324 | 1227 | 1132 | 1039 | 14 |
| 15 | 2188 | 2070 | 1955 | 1843 | 1734 | 1627 | 1523 | 1422 | 1322 | 1225 | 1130 | 1037 | 15 |
| 16 | 2186 | 2068 | 1953 | 1841 | 1732 | 1626 | 1522 | 1420 | 1321 | 1224 | 1129 | 1036 | 16 |
| 17 | 2184 | 2066 | 1951 | 1839 | 1730 | 1624 | 1520 | 1418 | 1319 | 1222 | 1127 | 1034 | 17 |
| 18 | 2182 | 2064 | 1950 | 1838 | 1728 | 1622 | 1518 | 1417 | 1317 | 1221 | 1126 | 1033 | 18 |
| 19 | 2180 | 2062 | 1948 | 1836 | 1727 | 1620 | 1516 | 1415 | 1316 | 1219 | 1124 | 1031 | 19 |
| 20 | 2178 | 2061 | 1946 | 1834 | 1725 | 1619 | 1515 | 1413 | 1314 | 1217 | 1123 | 1030 | 20 |
| 21 | 2176 | 2059 | 1944 | 1832 | 1723 | 1617 | 1513 | 1412 | 1313 | 1216 | 1121 | 1028 | 21 |
| 22 | 2174 | 2057 | 1942 | 1830 | 1721 | 1615 | 1511 | 1410 | 1311 | 1214 | 1119 | 1027 | 22 |
| 23 | 2172 | 2055 | 1940 | 1828 | 1719 | 1613 | 1510 | 1408 | 1309 | 1213 | 1118 | 1025 | 23 |
| 24 | 2170 | 2053 | 1938 | 1827 | 1718 | 1612 | 1508 | 1407 | 1308 | 1211 | 1116 | 1024 | 24 |
| 25 | 2169 | 2051 | 1936 | 1825 | 1716 | 1610 | 1506 | 1405 | 1306 | 1209 | 1115 | 1022 | 25 |
| 26 | 2167 | 2049 | 1934 | 1823 | 1714 | 1608 | 1504 | 1403 | 1304 | 1208 | 1113 | 1021 | 26 |
| 27 | 2165 | 2047 | 1933 | 1821 | 1712 | 1606 | 1503 | 1402 | 1303 | 1206 | 1112 | 1019 | 27 |
| 28 | 2163 | 2045 | 1931 | 1819 | 1711 | 1605 | 1501 | 1400 | 1301 | 1205 | 1110 | 1018 | 28 |
| 29 | 2161 | 2043 | 1929 | 1817 | 1709 | 1603 | 1499 | 1398 | 1300 | 1203 | 1109 | 1016 | 29 |
| 30 | 2159 | 2041 | 1927 | 1816 | 1707 | 1601 | 1498 | 1397 | 1298 | 1201 | 1107 | 1015 | 30 |
| 31 | 2157 | 2039 | 1925 | 1814 | 1705 | 1599 | 1496 | 1395 | 1296 | 1200 | 1105 | 1013 | 31 |
| 32 | 2155 | 2037 | 1923 | 1812 | 1703 | 1598 | 1494 | 1393 | 1295 | 1198 | 1104 | 1012 | 32 |
| 33 | 2153 | 2035 | 1921 | 1810 | 1702 | 1596 | 1493 | 1392 | 1293 | 1197 | 1102 | 1010 | 33 |
| 34 | 2151 | 2033 | 1919 | 1808 | 1700 | 1594 | 1491 | 1390 | 1291 | 1195 | 1101 | 1008 | 34 |
| 35 | 2149 | 2032 | 1918 | 1806 | 1698 | 1592 | 1489 | 1388 | 1290 | 1193 | 1099 | 1007 | 35 |
| 36 | 2147 | 2030 | 1916 | 1805 | 1696 | 1591 | 1487 | 1387 | 1288 | 1192 | 1098 | 1005 | 36 |
| 37 | 2145 | 2028 | 1914 | 1803 | 1694 | 1589 | 1486 | 1385 | 1287 | 1190 | 1096 | 1004 | 37 |
| 38 | 2143 | 2026 | 1912 | 1801 | 1693 | 1587 | 1484 | 1383 | 1285 | 1189 | 1095 | 1002 | 38 |
| 39 | 2141 | 2024 | 1910 | 1799 | 1691 | 1585 | 1482 | 1382 | 1283 | 1187 | 1093 | 1001 | 39 |
| 40 | 2139 | 2022 | 1908 | 1797 | 1689 | 1584 | 1481 | 1380 | 1282 | 1186 | 1091 | 0999 | 40 |
| 41 | 2137 | 2020 | 1906 | 1795 | 1687 | 1582 | 1479 | 1378 | 1280 | 1184 | 1090 | 0998 | 41 |
| 42 | 2135 | 2018 | 1904 | 1794 | 1686 | 1580 | 1477 | 1377 | 1278 | 1182 | 1088 | 0996 | 42 |
| 43 | 2133 | 2016 | 1903 | 1792 | 1684 | 1578 | 1476 | 1375 | 1277 | 1181 | 1087 | 0995 | 43 |
| 44 | 2131 | 2014 | 1901 | 1790 | 1682 | 1577 | 1474 | 1373 | 1275 | 1179 | 1085 | 0993 | 44 |
| 45 | 2129 | 2012 | 1899 | 1788 | 1680 | 1575 | 1472 | 1372 | 1274 | 1178 | 1084 | 0992 | 45 |
| 46 | 2127 | 2010 | 1897 | 1786 | 1678 | 1573 | 1470 | 1370 | 1272 | 1176 | 1082 | 0990 | 46 |
| 47 | 2125 | 2009 | 1895 | 1785 | 1677 | 1571 | 1469 | 1368 | 1270 | 1174 | 1081 | 0989 | 47 |
| 48 | 2123 | 2007 | 1893 | 1783 | 1675 | 1570 | 1467 | 1367 | 1269 | 1173 | 1079 | 0987 | 48 |
| 49 | 2121 | 2005 | 1891 | 1781 | 1673 | 1568 | 1465 | 1365 | 1267 | 1171 | 1078 | 0986 | 49 |
| 50 | 2119 | 2003 | 1889 | 1779 | 1671 | 1566 | 1464 | 1363 | 1266 | 1170 | 1076 | 0984 | 50 |
| 51 | 2117 | 2001 | 1888 | 1777 | 1670 | 1565 | 1462 | 1362 | 1264 | 1168 | 1074 | 0983 | 51 |
| 52 | 2115 | 1999 | 1886 | 1775 | 1668 | 1563 | 1460 | 1360 | 1262 | 1167 | 1073 | 0981 | 52 |
| 53 | 2113 | 1997 | 1884 | 1774 | 1666 | 1561 | 1459 | 1359 | 1261 | 1165 | 1071 | 0980 | 53 |
| 54 | 2111 | 1995 | 1882 | 1772 | 1664 | 1559 | 1457 | 1357 | 1259 | 1163 | 1070 | 0978 | 54 |
| 55 | 2109 | 1993 | 1880 | 1770 | 1663 | 1558 | 1455 | 1355 | 1257 | 1162 | 1068 | 0977 | 55 |
| 56 | 2107 | 1991 | 1878 | 1768 | 1661 | 1556 | 1454 | 1354 | 1256 | 1160 | 1067 | 0975 | 56 |
| 57 | 2105 | 1989 | 1876 | 1766 | 1659 | 1554 | 1452 | 1352 | 1254 | 1159 | 1065 | 0974 | 57 |
| 58 | 2103 | 1987 | 1875 | 1765 | 1657 | 1552 | 1450 | 1350 | 1253 | 1157 | 1064 | 0972 | 58 |
| 59 | 2101 | 1986 | 1873 | 1763 | 1655 | 1551 | 1449 | 1349 | 1251 | 1156 | 1062 | 0971 | 59 |
| 60 | 2099 | 1984 | 1871 | 1761 | 1654 | 1549 | 1447 | 1347 | 1249 | 1154 | 1061 | 0969 | 60 |



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# TABLE XLVII.

LOGARITHMS for finding the Correction to reduce the MOON'S Declination or Right Ascension to any Time under the Meridian of Greenwich.

| Sec. or " | MINUTES OF AN HOUR OR A DEGREE. | | | | | | | | | | | | Sec. or " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | |
| 0 | 0969 | 0880 | 0792 | 0706 | 0621 | 0539 | 0458 | 0378 | 0300 | 0223 | 0147 | 0073 | 0 |
| 1 | 0968 | 0878 | 0790 | 0704 | 0620 | 0537 | 0456 | 0377 | 0298 | 0221 | 0146 | 0072 | 1 |
| 2 | 0966 | 0877 | 0789 | 0703 | 0619 | 0536 | 0455 | 0375 | 0297 | 0220 | 0145 | 0071 | 2 |
| 3 | 0965 | 0875 | 0787 | 0702 | 0617 | 0535 | 0454 | 0374 | 0296 | 0219 | 0143 | 0069 | 3 |
| 4 | 0963 | 0874 | 0786 | 0700 | 0616 | 0533 | 0452 | 0373 | 0294 | 0218 | 0142 | 0068 | 4 |
| 5 | 0962 | 0872 | 0785 | 0699 | 0615 | 0532 | 0451 | 0371 | 0293 | 0216 | 0141 | 0067 | 5 |
| 6 | 0960 | 0871 | 0783 | 0697 | 0613 | 0531 | 0450 | 0370 | 0292 | 0215 | 0140 | 0066 | 6 |
| 7 | 0959 | 0869 | 0782 | 0696 | 0612 | 0529 | 0448 | 0369 | 0291 | 0214 | 0139 | 0064 | 7 |
| 8 | 0957 | 0868 | 0780 | 0694 | 0610 | 0528 | 0447 | 0367 | 0289 | 0213 | 0137 | 0063 | 8 |
| 9 | 0956 | 0866 | 0779 | 0693 | 0609 | 0526 | 0446 | 0366 | 0288 | 0211 | 0136 | 0062 | 9 |
| 10 | 0954 | 0865 | 0777 | 0692 | 0608 | 0525 | 0444 | 0365 | 0287 | 0210 | 0135 | 0061 | 10 |
| 11 | 0953 | 0863 | 0776 | 0690 | 0606 | 0524 | 0443 | 0363 | 0285 | 0209 | 0134 | 0060 | 11 |
| 12 | 0951 | 0862 | 0774 | 0689 | 0605 | 0522 | 0442 | 0362 | 0284 | 0208 | 0132 | 0058 | 12 |
| 13 | 0950 | 0860 | 0773 | 0687 | 0603 | 0521 | 0440 | 0361 | 0283 | 0206 | 0131 | 0057 | 13 |
| 14 | 0948 | 0859 | 0772 | 0686 | 0602 | 0520 | 0439 | 0359 | 0282 | 0205 | 0130 | 0056 | 14 |
| 15 | 0947 | 0857 | 0770 | 0685 | 0601 | 0518 | 0438 | 0358 | 0280 | 0204 | 0129 | 0055 | 15 |
| 16 | 0945 | 0856 | 0769 | 0683 | 0599 | 0517 | 0436 | 0357 | 0279 | 0202 | 0127 | 0053 | 16 |
| 17 | 0944 | 0855 | 0767 | 0682 | 0598 | 0516 | 0435 | 0356 | 0278 | 0201 | 0126 | 0052 | 17 |
| 18 | 0942 | 0853 | 0766 | 0680 | 0596 | 0514 | 0434 | 0354 | 0276 | 0200 | 0125 | 0051 | 18 |
| 19 | 0941 | 0852 | 0764 | 0679 | 0595 | 0513 | 0432 | 0353 | 0275 | 0199 | 0124 | 0050 | 19 |
| 20 | 0939 | 0850 | 0763 | 0678 | 0594 | 0512 | 0431 | 0352 | 0274 | 0197 | 0122 | 0049 | 20 |
| 21 | 0938 | 0849 | 0762 | 0676 | 0592 | 0510 | 0430 | 0350 | 0273 | 0196 | 0121 | 0047 | 21 |
| 22 | 0936 | 0847 | 0760 | 0675 | 0591 | 0509 | 0428 | 0349 | 0271 | 0195 | 0120 | 0046 | 22 |
| 23 | 0935 | 0846 | 0759 | 0673 | 0590 | 0507 | 0427 | 0348 | 0270 | 0194 | 0119 | 0045 | 23 |
| 24 | 0933 | 0844 | 0757 | 0672 | 0588 | 0506 | 0426 | 0346 | 0269 | 0192 | 0117 | 0044 | 24 |
| 25 | 0932 | 0843 | 0756 | 0670 | 0587 | 0505 | 0424 | 0345 | 0267 | 0191 | 0116 | 0042 | 25 |
| 26 | 0930 | 0841 | 0754 | 0669 | 0585 | 0503 | 0423 | 0344 | 0266 | 0190 | 0115 | 0041 | 26 |
| 27 | 0929 | 0840 | 0753 | 0668 | 0584 | 0502 | 0422 | 0342 | 0265 | 0189 | 0114 | 0040 | 27 |
| 28 | 0927 | 0838 | 0751 | 0666 | 0583 | 0501 | 0420 | 0341 | 0264 | 0187 | 0112 | 0039 | 28 |
| 29 | 0926 | 0837 | 0750 | 0665 | 0581 | 0499 | 0419 | 0340 | 0262 | 0186 | 0111 | 0038 | 29 |
| 30 | 0924 | 0835 | 0749 | 0663 | 0580 | 0498 | 0418 | 0339 | 0261 | 0185 | 0110 | 0036 | 30 |
| 31 | 0923 | 0834 | 0747 | 0662 | 0579 | 0497 | 0416 | 0337 | 0260 | 0184 | 0109 | 0035 | 31 |
| 32 | 0921 | 0833 | 0746 | 0661 | 0577 | 0495 | 0415 | 0336 | 0258 | 0182 | 0107 | 0034 | 32 |
| 33 | 0920 | 0831 | 0744 | 0659 | 0576 | 0494 | 0414 | 0335 | 0257 | 0181 | 0106 | 0033 | 33 |
| 34 | 0918 | 0830 | 0743 | 0658 | 0574 | 0493 | 0412 | 0333 | 0256 | 0180 | 0105 | 0031 | 34 |
| 35 | 0917 | 0828 | 0741 | 0656 | 0573 | 0491 | 0411 | 0332 | 0255 | 0179 | 0104 | 0030 | 35 |
| 36 | 0915 | 0827 | 0740 | 0655 | 0572 | 0490 | 0410 | 0331 | 0253 | 0177 | 0103 | 0029 | 36 |
| 37 | 0914 | 0825 | 0739 | 0654 | 0570 | 0489 | 0408 | 0329 | 0252 | 0176 | 0101 | 0028 | 37 |
| 38 | 0912 | 0824 | 0737 | 0652 | 0569 | 0487 | 0407 | 0328 | 0251 | 0175 | 0100 | 0027 | 38 |
| 39 | 0911 | 0822 | 0736 | 0651 | 0568 | 0486 | 0406 | 0327 | 0250 | 0174 | 0099 | 0025 | 39 |
| 40 | 0909 | 0821 | 0734 | 0649 | 0566 | 0484 | 0404 | 0326 | 0248 | 0172 | 0098 | 0024 | 40 |
| 41 | 0908 | 0819 | 0733 | 0648 | 0565 | 0483 | 0403 | 0324 | 0247 | 0171 | 0096 | 0023 | 41 |
| 42 | 0906 | 0818 | 0731 | 0647 | 0563 | 0482 | 0402 | 0323 | 0246 | 0170 | 0095 | 0022 | 42 |
| 43 | 0905 | 0816 | 0730 | 0645 | 0562 | 0480 | 0400 | 0322 | 0244 | 0169 | 0094 | 0021 | 43 |
| 44 | 0903 | 0815 | 0729 | 0644 | 0561 | 0479 | 0399 | 0320 | 0243 | 0167 | 0093 | 0019 | 44 |
| 45 | 0902 | 0814 | 0727 | 0642 | 0559 | 0478 | 0398 | 0319 | 0242 | 0166 | 0091 | 0018 | 45 |
| 46 | 0900 | 0812 | 0726 | 0641 | 0558 | 0476 | 0396 | 0318 | 0241 | 0165 | 0090 | 0017 | 46 |
| 47 | 0899 | 0811 | 0724 | 0640 | 0557 | 0475 | 0395 | 0316 | 0239 | 0163 | 0089 | 0016 | 47 |
| 48 | 0897 | 0809 | 0723 | 0638 | 0555 | 0474 | 0394 | 0315 | 0238 | 0162 | 0088 | 0015 | 48 |
| 49 | 0896 | 0808 | 0721 | 0637 | 0554 | 0472 | 0392 | 0314 | 0237 | 0161 | 0087 | 0013 | 49 |
| 50 | 0894 | 0806 | 0720 | 0635 | 0552 | 0471 | 0391 | 0313 | 0235 | 0160 | 0085 | 0012 | 50 |
| 51 | 0893 | 0805 | 0719 | 0634 | 0551 | 0470 | 0390 | 0311 | 0234 | 0158 | 0084 | 0011 | 51 |
| 52 | 0891 | 0803 | 0717 | 0633 | 0550 | 0468 | 0388 | 0310 | 0233 | 0157 | 0083 | 0010 | 52 |
| 53 | 0890 | 0802 | 0716 | 0631 | 0548 | 0467 | 0387 | 0309 | 0232 | 0156 | 0082 | 0008 | 53 |
| 54 | 0888 | 0801 | 0714 | 0630 | 0547 | 0466 | 0386 | 0307 | 0230 | 0155 | 0080 | 0007 | 54 |
| 55 | 0887 | 0799 | 0713 | 0628 | 0546 | 0464 | 0384 | 0306 | 0229 | 0153 | 0079 | 0006 | 55 |
| 56 | 0885 | 0798 | 0711 | 0627 | 0544 | 0463 | 0383 | 0305 | 0228 | 0152 | 0078 | 0005 | 56 |
| 57 | 0884 | 0796 | 0710 | 0626 | 0543 | 0462 | 0382 | 0304 | 0227 | 0151 | 0077 | 0004 | 57 |
| 58 | 0883 | 0795 | 0709 | 0624 | 0541 | 0460 | 0381 | 0302 | 0225 | 0150 | 0075 | 0002 | 58 |
| 59 | 0881 | 0793 | 0707 | 0623 | 0540 | 0459 | 0379 | 0301 | 0224 | 0148 | 0074 | 0001 | 59 |
| 60 | 0880 | 0792 | 0706 | 0621 | 0539 | 0458 | 0378 | 0300 | 0223 | 0147 | 0073 | 0000 | 60 |

## TABLE XLVIII.

### The Parallax in Altitude for Planets.

| Planet's App. Alt. | Planet's Horizontal Parallax. | | | | | | | | | | | | | | | | | Planet's App. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1″ | 3″ | 5″ | 7″ | 9″ | 11″ | 13″ | 15″ | 17″ | 19″ | 21″ | 23″ | 25″ | 27″ | 29″ | 31″ | 33″ | |
| 3° | 1″ | 3″ | 5″ | 7″ | 9″ | 11″ | 13″ | 15″ | 17″ | 19″ | 21″ | 23″ | 25″ | 27″ | 29″ | 31″ | 33″ | 3° |
| 4 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 4 |
| 5 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 5 |
| 6 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 6 |
| 7 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 7 |
| 8 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 8 |
| 9 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 9 |
| 10 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 32 | 10 |
| 11 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 26 | 28 | 30 | 32 | 11 |
| 12 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 22 | 24 | 26 | 28 | 30 | 32 | 12 |
| 14 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 14 |
| 16 | 1 | 3 | 5 | 7 | 9 | 11 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 16 |
| 18 | 1 | 3 | 5 | 7 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 29 | 31 | 18 |
| 20 | 1 | 3 | 5 | 7 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 27 | 29 | 31 | 20 |
| 23 | 1 | 3 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 30 | 23 |
| 26 | 1 | 3 | 4 | 6 | 8 | 10 | 12 | 13 | 15 | 17 | 19 | 21 | 22 | 24 | 26 | 28 | 30 | 26 |
| 29 | 1 | 3 | 4 | 6 | 8 | 10 | 11 | 13 | 15 | 17 | 18 | 20 | 22 | 24 | 25 | 27 | 29 | 29 |
| 32 | 1 | 2 | 4 | 6 | 8 | 9 | 11 | 13 | 14 | 16 | 18 | 19 | 21 | 23 | 25 | 26 | 28 | 32 |
| 35 | 1 | 2 | 4 | 6 | 7 | 9 | 11 | 12 | 14 | 16 | 17 | 19 | 20 | 22 | 24 | 25 | 27 | 35 |
| 40 | 1 | 2 | 4 | 5 | 7 | 8 | 10 | 12 | 13 | 15 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 40 |
| 45 | 1 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 13 | 15 | 16 | 18 | 19 | 21 | 22 | 23 | 45 |
| 50 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 10 | 11 | 12 | 13 | 15 | 16 | 17 | 19 | 20 | 21 | 50 |
| 55 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 17 | 18 | 19 | 55 |
| 60 | 0 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 60 |
| 65 | 0 | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 65 |
| 70 | 0 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 6 | 6 | 7 | 8 | 9 | 9 | 10 | 11 | 11 | 70 |
| 75 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 8 | 8 | 75 |
| 80 | 0 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 80 |
| 85 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 85 |
| 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90 |

## TABLE XLIX

### To correct the Logarithmic Difference when a Planet is observed.

| Planet's App. Alt. | Planet's Horizontal Parallax. | | | | | | | | | | | | | | | | | Planet's App. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1″ | 3″ | 5″ | 7″ | 9″ | 11″ | 13″ | 15″ | 17″ | 19″ | 21″ | 23″ | 25″ | 27″ | 29″ | 31″ | 33″ | |
| 3° | 27 | 28 | 28 | 28 | 28 | 28 | 29 | 29 | 29 | 29 | 29 | 30 | 30 | 30 | 30 | 30 | 31 | 3° |
| 4 | 18 | 18 | 19 | 19 | 19 | 19 | 20 | 20 | 20 | 21 | 21 | 21 | 21 | 22 | 22 | 22 | 23 | 4 |
| 5 | 12 | 13 | 13 | 14 | 14 | 14 | 15 | 15 | 15 | 16 | 16 | 17 | 17 | 17 | 17 | 18 | 18 | 5 |
| 6 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 13 | 14 | 14 | 15 | 15 | 16 | 16 | 6 |
| 7 | 8 | 8 | 8 | 9 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 14 | 15 | 15 | 15 | 7 |
| 8 | 6 | 7 | 7 | 8 | 8 | 9 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 14 | 14 | 15 | 15 | 8 |
| 9 | 5 | 6 | 6 | 7 | 7 | 8 | 9 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 14 | 15 | 15 | 9 |
| 10 | 4 | 5 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 14 | 15 | 15 | 10 |
| 11 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 15 | 15 | 16 | 11 |
| 12 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 16 | 17 | 12 |
| 14 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 10 | 11 | 13 | 14 | 15 | 16 | 17 | 17 | 18 | 14 |
| 16 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 16 |
| 18 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 11 | 12 | 13 | 15 | 16 | 18 | 19 | 20 | 21 | 22 | 18 |
| 20 | 2 | 3 | 4 | 6 | 8 | 9 | 10 | 12 | 13 | 14 | 16 | 18 | 20 | 21 | 22 | 23 | 25 | 20 |
| 23 | 2 | 3 | 4 | 7 | 8 | 10 | 11 | 13 | 14 | 16 | 18 | 20 | 22 | 23 | 25 | 26 | 28 | 23 |
| 26 | 2 | 3 | 4 | 7 | 9 | 11 | 13 | 14 | 16 | 17 | 20 | 21 | 24 | 25 | 28 | 29 | 31 | 26 |
| 29 | 2 | 3 | 4 | 7 | 9 | 12 | 14 | 15 | 17 | 19 | 22 | 23 | 26 | 27 | 31 | 32 | 34 | 29 |
| 32 | 2 | 3 | 5 | 8 | 10 | 13 | 15 | 17 | 19 | 21 | 24 | 25 | 28 | 30 | 34 | 35 | 37 | 32 |
| 35 | 2 | 3 | 6 | 9 | 11 | 14 | 17 | 19 | 21 | 23 | 26 | 28 | 31 | 33 | 37 | 38 | 42 | 35 |
| 40 | 2 | 3 | 7 | 9 | 12 | 15 | 18 | 21 | 23 | 26 | 28 | 31 | 34 | 37 | 40 | 42 | 46 | 40 |
| 45 | 2 | 4 | 7 | 10 | 13 | 17 | 19 | 23 | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 45 |
| 50 | 2 | 5 | 8 | 11 | 14 | 18 | 21 | 24 | 27 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 54 | 50 |
| 55 | 2 | 6 | 9 | 12 | 15 | 19 | 22 | 26 | 29 | 33 | 36 | 40 | 43 | 46 | 49 | 54 | 57 | 55 |
| 60 | 2 | 6 | 9 | 13 | 16 | 20 | 23 | 27 | 31 | 35 | 38 | 42 | 46 | 49 | 52 | 57 | 60 | 60 |
| 65 | 2 | 6 | 10 | 13 | 17 | 21 | 24 | 29 | 32 | 36 | 40 | 44 | 48 | 51 | 55 | 59 | 63 | 65 |
| 70 | 2 | 6 | 10 | 14 | 18 | 22 | 25 | 30 | 33 | 38 | 42 | 46 | 49 | 53 | 57 | 61 | 65 | 70 |
| 75 | 2 | 6 | 10 | 14 | 18 | 22 | 26 | 30 | 34 | 39 | 43 | 47 | 50 | 55 | 59 | 63 | 67 | 75 |
| 80 | 2 | 6 | 10 | 14 | 19 | 23 | 27 | 31 | 35 | 39 | 44 | 48 | 51 | 56 | 60 | 64 | 68 | 80 |
| 85 | 2 | 6 | 10 | 15 | 19 | 23 | 27 | 31 | 36 | 40 | 44 | 48 | 52 | 57 | 61 | 65 | 69 | 85 |
| 90 | 2 | 6 | 10 | 15 | 19 | 23 | 27 | 31 | 36 | 40 | 44 | 48 | 52 | 57 | 61 | 65 | 69 | 90 |

To correct the Auxiliary Angle when a Planet is observed.—Additive.

| Planet's App. Alt. | Planet's Horizontal Parallax. | | | | | | | | | | | | | | | | Planet's App. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1″ | 3″ | 5″ | 7″ | 9″ | 11″ | 13″ | 15″ | 17″ | 19″ | 21″ | 23″ | 25″ | 27″ | 29″ | 31″ | 33″ | |
| 3° | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 8″ | 3° |
| 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 |
| 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 6 |
| 7 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 7 |
| 8 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 8 |
| 9 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 9 |
| 10 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 10 |
| 11 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 11 |
| 12 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 12 |
| 14 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 14 |
| 16 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 16 |
| 18 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 18 |
| 20 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 6 | 7 | 20 |
| 23 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 7 | 8 | 23 |
| 26 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 4 | 4 | 5 | 6 | 6 | 7 | 7 | 8 | 8 | 8 | 26 |
| 29 | 1 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 8 | 8 | 9 | 29 |
| 32 | 1 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 8 | 9 | 10 | 10 | 32 |
| 35 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 6 | 6 | 6 | 7 | 7 | 8 | 8 | 9 | 10 | 11 | 35 |
| 40 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 6 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 11 | 12 | 40 |
| 45 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 10 | 11 | 12 | 13 | 14 | 45 |
| 50 | 1 | 1 | 3 | 3 | 4 | 4 | 6 | 7 | 8 | 9 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 50 |
| 55 | 1 | 1 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 55 |
| 60 | 1 | 1 | 3 | 4 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 13 | 14 | 14 | 16 | 17 | 60 |
| 65 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 65 |
| 70 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 15 | 16 | 17 | 18 | 70 |
| 75 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 75 |
| 80 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 18 | 19 | 80 |
| 85 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 11 | 12 | 13 | 14 | 16 | 17 | 18 | 19 | 85 |
| 90 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 11 | 12 | 13 | 14 | 16 | 17 | 18 | 19 | 90 |

## TABLE LI.

To reduce the EQUATION OF TIME to any Time under the Meridian of Greenwich.

| Greenw. Time. | DAILY VARIATION. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1s | 2s | 4s | 6s | 8s | 10s | 12s | 14s | 16s | 18s | 20s | 22s | 24s | 26s | 28s | 30s |
| h. m. | s | s | s | s | s | s | s | s | s | s | s | s | s | s | s | s |
| 0 30 | 0.0 | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 |
| 1 0 | 0.0 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.8 | 0.9 | 1.0 | 1.1 | 1.2 | 1.2 |
| 1 30 | 0.1 | 0.1 | 0.2 | 0.4 | 0.5 | 0.6 | 0.8 | 0.9 | 1.0 | 1.1 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 |
| 2 0 | 0.1 | 0.2 | 0.3 | 0.5 | 0.7 | 0.8 | 1.0 | 1.2 | 1.3 | 1.5 | 1.7 | 1.8 | 2.0 | 2.2 | 2.3 | 2.5 |
| 2 30 | 0.1 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.3 | 1.5 | 1.7 | 1.9 | 2.1 | 2.3 | 2.5 | 2.7 | 2.9 | 3.1 |
| 3 0 | 0.1 | 0.3 | 0.5 | 0.7 | 1.0 | 1.2 | 1.5 | 1.8 | 2.0 | 2.2 | 2.5 | 2.7 | 3.0 | 3.2 | 3.5 | 3.7 |
| 3 30 | 0.1 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5 | 1.8 | 2.0 | 2.3 | 2.6 | 2.9 | 3.2 | 3.5 | 3.7 | 4.1 | 4.4 |
| 4 0 | 0.2 | 0.3 | 0.7 | 1.0 | 1.3 | 1.7 | 2.0 | 2.3 | 2.6 | 3.0 | 3.3 | 3.7 | 4.0 | 4.3 | 4.7 | 5.0 |
| 4 30 | 0.2 | 0.4 | 0.7 | 1.1 | 1.5 | 1.9 | 2.3 | 2.6 | 3.0 | 3.4 | 3.7 | 4.1 | 4.5 | 4.9 | 5.2 | 5.6 |
| 5 0 | 0.2 | 0.4 | 0.8 | 1.2 | 1.7 | 2.1 | 2.5 | 2.9 | 3.3 | 3.8 | 4.2 | 4.6 | 5.0 | 5.4 | 5.8 | 6.2 |
| 5 30 | 0.2 | 0.5 | 0.9 | 1.4 | 1.8 | 2.3 | 2.8 | 3.2 | 3.7 | 4.1 | 4.6 | 5.0 | 5.5 | 5.9 | 6.4 | 6.8 |
| 6 0 | 0.2 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 | 7.5 |
| 6 30 | 0.3 | 0.5 | 1.1 | 1.6 | 2.2 | 2.7 | 3.3 | 3.8 | 4.3 | 4.9 | 5.4 | 5.9 | 6.5 | 7.0 | 7.6 | 8.1 |
| 7 0 | 0.3 | 0.6 | 1.2 | 1.7 | 2.3 | 2.9 | 3.5 | 4.1 | 4.7 | 5.2 | 5.8 | 6.4 | 7.0 | 7.5 | 8.1 | 8.7 |
| 7 30 | 0.3 | 0.6 | 1.2 | 1.9 | 2.5 | 3.1 | 3.8 | 4.4 | 5.0 | 5.6 | 6.3 | 6.9 | 7.5 | 8.1 | 8.7 | 9.4 |
| 8 0 | 0.3 | 0.7 | 1.3 | 2.0 | 2.7 | 3.3 | 4.0 | 4.7 | 5.3 | 6.0 | 6.7 | 7.3 | 8.0 | 8.6 | 9.3 | 10.0 |
| 8 30 | 0.4 | 0.7 | 1.4 | 2.1 | 2.8 | 3.5 | 4.3 | 5.0 | 5.7 | 6.4 | 7.1 | 7.8 | 8.5 | 9.2 | 9.9 | 10.6 |
| 9 0 | 0.4 | 0.7 | 1.5 | 2.2 | 3.0 | 3.7 | 4.5 | 5.2 | 6.0 | 6.8 | 7.5 | 8.2 | 9.0 | 9.7 | 10.4 | 11.2 |
| 9 30 | 0.4 | 0.8 | 1.6 | 2.4 | 3.2 | 4.0 | 4.8 | 5.5 | 6.3 | 7.1 | 7.9 | 8.7 | 9.5 | 10.2 | 11.0 | 11.8 |
| 10 0 | 0.4 | 0.8 | 1.7 | 2.5 | 3.3 | 4.2 | 5.0 | 5.8 | 6.7 | 7.5 | 8.3 | 9.2 | 10.0 | 10.8 | 11.6 | 12.5 |
| 10 30 | 0.4 | 0.9 | 1.7 | 2.6 | 3.5 | 4.4 | 5.3 | 6.1 | 7.0 | 7.9 | 8.7 | 9.6 | 10.5 | 11.4 | 12.2 | 13.1 |
| 11 0 | 0.5 | 0.9 | 1.8 | 2.7 | 3.7 | 4.6 | 5.5 | 6.4 | 7.3 | 8.2 | 9.2 | 10.0 | 11.0 | 11.9 | 12.8 | 13.7 |
| 11 30 | 0.5 | 1.0 | 1.9 | 2.9 | 3.8 | 4.8 | 5.8 | 6.7 | 7.7 | 8.6 | 9.6 | 10.5 | 11.5 | 12.4 | 13.4 | 14.4 |
| 12 0 | 0.5 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 |

# TABLE LII.

## Logarithms for computing the Equation of Equal Altitudes.

| Interval. | Log. A. | Log. B. | Interval. | Log. A. | Log. B. | Interval. | Log. A. | Log. B. | Interval. | Log. A. | Log. B. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| h. m. | | | h. m. | | | h. m. | | | h. m. | | |
| 2 0 | 7.7297 | 7.7146 | 4 0 | 7.7447 | 7.6823 | 6 0 | 7.7703 | 7.6198 | 8 0 | 7.8072 | 7.5062 |
| 2 | 7.7298 | 7.7143 | 2 | 7.7451 | 7.6815 | 2 | 7.7708 | 7.6184 | 2 | 7.8079 | 7.5036 |
| 4 | 7.7300 | 7.7139 | 4 | 7.7454 | 7.6807 | 4 | 7.7713 | 7.6170 | 4 | 7.8086 | 7.5010 |
| 6 | 7.7302 | 7.7136 | 6 | 7.7458 | 7.6800 | 6 | 7.7719 | 7.6156 | 6 | 7.8094 | 7.4983 |
| 8 | 7.7304 | 7.7132 | 8 | 7.7461 | 7.6792 | 8 | 7.7724 | 7.6142 | 8 | 7.8101 | 7.4957 |
| 10 | 7.7305 | 7.7128 | 10 | 7.7464 | 7.6784 | 10 | 7.7729 | 7.6127 | 10 | 7.8108 | 7.4930 |
| 12 | 7.7307 | 7.7125 | 12 | 7.7468 | 7.6776 | 12 | 7.7735 | 7.6113 | 12 | 7.8116 | 7.4902 |
| 14 | 7.7309 | 7.7121 | 14 | 7.7472 | 7.6768 | 14 | 7.7740 | 7.6098 | 14 | 7.8123 | 7.4874 |
| 16 | 7.7311 | 7.7117 | 16 | 7.7475 | 7.6759 | 16 | 7.7745 | 7.6083 | 16 | 7.8130 | 7.4846 |
| 18 | 7.7313 | 7.7113 | 18 | 7.7479 | 7.6751 | 18 | 7.7751 | 7.6068 | 18 | 7.8138 | 7.4818 |
| 2 20 | 7.7315 | 7.7109 | 4 20 | 7.7482 | 7.6743 | 6 20 | 7.7756 | 7.6053 | 8 20 | 7.8145 | 7.4789 |
| 22 | 7.7317 | 7.7105 | 22 | 7.7486 | 7.6734 | 22 | 7.7762 | 7.6038 | 22 | 7.8153 | 7.4760 |
| 24 | 7.7319 | 7.7101 | 24 | 7.7490 | 7.6726 | 24 | 7.7767 | 7.6023 | 24 | 7.8160 | 7.4731 |
| 26 | 7.7321 | 7.7097 | 26 | 7.7494 | 7.6717 | 26 | 7.7773 | 7.6007 | 26 | 7.8168 | 7.4701 |
| 28 | 7.7323 | 7.7092 | 28 | 7.7497 | 7.6708 | 28 | 7.7779 | 7.5991 | 28 | 7.8176 | 7.4671 |
| 30 | 7.7325 | 7.7088 | 30 | 7.7501 | 7.6700 | 30 | 7.7784 | 7.5975 | 30 | 7.8183 | 7.4640 |
| 32 | 7.7327 | 7.7083 | 32 | 7.7505 | 7.6691 | 32 | 7.7790 | 7.5959 | 32 | 7.8191 | 7.4609 |
| 34 | 7.7329 | 7.7079 | 34 | 7.7509 | 7.6682 | 34 | 7.7796 | 7.5943 | 34 | 7.8199 | 7.4578 |
| 36 | 7.7331 | 7.7075 | 36 | 7.7513 | 7.6673 | 36 | 7.7801 | 7.5927 | 36 | 7.8206 | 7.4546 |
| 38 | 7.7333 | 7.7070 | 38 | 7.7517 | 7.6663 | 38 | 7.7807 | 7.5910 | 38 | 7.8214 | 7.4514 |
| 2 40 | 7.7336 | 7.7065 | 4 40 | 7.7521 | 7.6654 | 6 40 | 7.7813 | 7.5894 | 8 40 | 7.8222 | 7.4482 |
| 42 | 7.7338 | 7.7061 | 42 | 7.7525 | 7.6645 | 42 | 7.7819 | 7.5877 | 42 | 7.8230 | 7.4449 |
| 44 | 7.7340 | 7.7056 | 44 | 7.7529 | 7.6635 | 44 | 7.7825 | 7.5860 | 44 | 7.8238 | 7.4415 |
| 46 | 7.7342 | 7.7051 | 46 | 7.7533 | 7.6626 | 46 | 7.7831 | 7.5843 | 46 | 7.8246 | 7.4381 |
| 48 | 7.7345 | 7.7046 | 48 | 7.7537 | 7.6616 | 48 | 7.7836 | 7.5825 | 48 | 7.8254 | 7.4347 |
| 50 | 7.7347 | 7.7041 | 50 | 7.7541 | 7.6606 | 50 | 7.7842 | 7.5808 | 50 | 7.8262 | 7.4312 |
| 52 | 7.7349 | 7.7036 | 52 | 7.7545 | 7.6597 | 52 | 7.7848 | 7.5790 | 52 | 7.8270 | 7.4277 |
| 54 | 7.7352 | 7.7031 | 54 | 7.7549 | 7.6587 | 54 | 7.7854 | 7.5772 | 54 | 7.8278 | 7.4241 |
| 56 | 7.7354 | 7.7026 | 56 | 7.7553 | 7.6577 | 56 | 7.7860 | 7.5754 | 56 | 7.8286 | 7.4205 |
| 58 | 7.7357 | 7.7021 | 58 | 7.7557 | 7.6567 | 58 | 7.7867 | 7.5736 | 58 | 7.8294 | 7.4168 |
| 3 0 | 7.7359 | 7.7015 | 5 0 | 7.7562 | 7.6556 | 7 0 | 7.7873 | 7.5717 | 9 0 | 7.8302 | 7.4131 |
| 2 | 7.7362 | 7.7010 | 2 | 7.7566 | 7.6546 | 2 | 7.7879 | 7.5699 | 2 | 7.8311 | 7.4093 |
| 4 | 7.7364 | 7.7005 | 4 | 7.7570 | 7.6536 | 4 | 7.7885 | 7.5680 | 4 | 7.8319 | 7.4055 |
| 6 | 7.7367 | 7.6999 | 6 | 7.7575 | 7.6525 | 6 | 7.7891 | 7.5661 | 6 | 7.8328 | 7.4016 |
| 8 | 7.7369 | 7.6993 | 8 | 7.7579 | 7.6514 | 8 | 7.7898 | 7.5641 | 8 | 7.8336 | 7.3977 |
| 10 | 7.7372 | 7.6988 | 10 | 7.7583 | 7.6504 | 10 | 7.7904 | 7.5622 | 10 | 7.8344 | 7.3937 |
| 12 | 7.7374 | 7.6982 | 12 | 7.7588 | 7.6493 | 12 | 7.7910 | 7.5602 | 12 | 7.8353 | 7.3896 |
| 14 | 7.7377 | 7.6976 | 14 | 7.7592 | 7.6482 | 14 | 7.7916 | 7.5582 | 14 | 7.8361 | 7.3855 |
| 16 | 7.7380 | 7.6970 | 16 | 7.7597 | 7.6471 | 16 | 7.7923 | 7.5562 | 16 | 7.8370 | 7.3813 |
| 18 | 7.7383 | 7.6964 | 18 | 7.7601 | 7.6460 | 18 | 7.7929 | 7.5542 | 18 | 7.8378 | 7.3771 |
| 3 20 | 7.7386 | 7.6958 | 5 20 | 7.7606 | 7.6448 | 7 20 | 7.7936 | 7.5522 | 9 20 | 7.8387 | 7.3728 |
| 22 | 7.7388 | 7.6952 | 22 | 7.7610 | 7.6437 | 22 | 7.7942 | 7.5501 | 22 | 7.8396 | 7.3684 |
| 24 | 7.7391 | 7.6946 | 24 | 7.7615 | 7.6425 | 24 | 7.7949 | 7.5480 | 24 | 7.8404 | 7.3639 |
| 26 | 7.7394 | 7.6940 | 26 | 7.7620 | 7.6414 | 26 | 7.7955 | 7.5459 | 26 | 7.8413 | 7.3594 |
| 28 | 7.7397 | 7.6934 | 28 | 7.7624 | 7.6402 | 28 | 7.7962 | 7.5437 | 28 | 7.8422 | 7.3548 |
| 30 | 7.7400 | 7.6927 | 30 | 7.7629 | 7.6390 | 30 | 7.7969 | 7.5416 | 30 | 7.8430 | 7.3501 |
| 32 | 7.7403 | 7.6921 | 32 | 7.7634 | 7.6378 | 32 | 7.7975 | 7.5394 | 32 | 7.8439 | 7.3454 |
| 34 | 7.7406 | 7.6914 | 34 | 7.7638 | 7.6366 | 34 | 7.7982 | 7.5372 | 34 | 7.8448 | 7.3406 |
| 36 | 7.7409 | 7.6908 | 36 | 7.7643 | 7.6354 | 36 | 7.7989 | 7.5350 | 36 | 7.8457 | 7.3357 |
| 38 | 7.7412 | 7.6901 | 38 | 7.7648 | 7.6342 | 38 | 7.7995 | 7.5327 | 38 | 7.8466 | 7.3307 |
| 3 40 | 7.7415 | 7.6894 | 5 40 | 7.7653 | 7.6329 | 7 40 | 7.8002 | 7.5304 | 9 40 | 7.8475 | 7.3256 |
| 42 | 7.7418 | 7.6888 | 42 | 7.7658 | 7.6317 | 42 | 7.8009 | 7.5281 | 42 | 7.8484 | 7.3205 |
| 44 | 7.7421 | 7.6881 | 44 | 7.7663 | 7.6304 | 44 | 7.8016 | 7.5258 | 44 | 7.8493 | 7.3152 |
| 46 | 7.7424 | 7.6874 | 46 | 7.7668 | 7.6291 | 46 | 7.8023 | 7.5234 | 46 | 7.8502 | 7.3099 |
| 48 | 7.7428 | 7.6867 | 48 | 7.7673 | 7.6278 | 48 | 7.8030 | 7.5211 | 48 | 7.8511 | 7.3045 |
| 50 | 7.7431 | 7.6859 | 50 | 7.7678 | 7.6265 | 50 | 7.8037 | 7.5186 | 50 | 7.8520 | 7.2989 |
| 52 | 7.7434 | 7.6852 | 52 | 7.7683 | 7.6252 | 52 | 7.8044 | 7.5162 | 52 | 7.8530 | 7.2933 |
| 54 | 7.7437 | 7.6845 | 54 | 7.7688 | 7.6239 | 54 | 7.8051 | 7.5137 | 54 | 7.8539 | 7.2876 |
| 56 | 7.7441 | 7.6838 | 56 | 7.7693 | 7.6225 | 56 | 7.8058 | 7.5112 | 56 | 7.8548 | 7.2817 |
| 58 | 7.7444 | 7.6830 | 58 | 7.7698 | 7.6212 | 58 | 7.8065 | 7.5087 | 58 | 7.8558 | 7.2758 |
| 4 0 | 7.7447 | 7.6823 | 6 0 | 7.7703 | 7.6198 | 8 0 | 7.8072 | 7.5062 | 10 0 | 7.8567 | 7.2697 |

# TABLE LIII.

## For converting Foreign Measures into English feet or fathoms, and the contrary.

| English feet. | French feet. | | Spanish feet. | Portuguese feet. | | Amsterdam feet. | Ryn-land feet. | Swedish feet. | Venetian feet. | | Russian feet. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English fathoms | French toises. | French brasses. | Spanish brazas. | | Portuguese braças. | | | Swedish fathoms | | Venetian passi. | |
| 1 | 0.94 | 1.13 | 1.08 | 0.93 | 0.83 | 1.08 | 0.97 | 1.03 | 0.88 | 1.05 | 0 87 |
| 2 | 1.88 | 2.25 | 2.16 | 1.85 | 1.67 | 2.15 | 1.94 | 2.05 | 1.75 | 2.11 | 1.75 |
| 3 | 2.82 | 3.38 | 3.24 | 2.78 | 2.50 | 3.23 | 2.92 | 3.08 | 2.63 | 3.16 | 2.62 |
| 4 | 3.76 | 4.50 | 4.32 | 3.71 | 3.33 | 4.31 | 3.89 | 4.11 | 3.51 | 4.21 | 3.49 |
| 5 | 4.70 | 5.63 | 5.40 | 4.63 | 4 17 | 5.39 | 4.86 | 5 14 | 4.39 | 5.26 | 4.36 |
| 6 | 5.63 | 6.76 | 6.48 | 5.56 | 5.00 | 6.46 | 5.83 | 6.16 | 5.26 | 6.32 | 5.24 |
| 7 | 6.57 | 7.88 | 7.55 | 6.49 | 5.83 | 7 54 | 6.80 | 7.19 | 6.14 | 7.37 | 6.11 |
| 8 | 7.51 | 9.01 | 8.63 | 7.41 | 6.67 | 8.61 | 7.77 | 8.22 | 7.02 | 8.42 | 6.98 |
| 9 | 8.45 | 10.13 | 9.71 | 8.34 | 7.50 | 9.70 | 8.75 | 9.25 | 7.90 | 9.47 | 7.85 |
| 10 | 9.39 | 11.26 | 10.79 | 9.27 | 8.33 | 10.77 | 9 71 | 10.27 | 8.77 | 10.52 | 8.73 |
| 11 | 10.33 | 12.39 | 11.87 | 10.20 | 9.17 | 11.85 | 10.69 | 11.30 | 9.65 | 11.58 | 9.60 |
| 12 | 11.27 | 13.51 | 12 95 | 11.12 | 10.00 | 12.93 | 11.66 | 12.33 | 10 53 | 12.63 | 10.47 |
| 13 | 12.21 | 14.64 | 14.03 | 12.05 | 10.83 | 14.00 | 12.63 | 13.36 | 11.40 | 13.68 | 11.35 |
| 14 | 13.15 | 15.76 | 15.11 | 12.97 | 11.67 | 15.08 | 13.60 | 14.38 | 12.28 | 14.74 | 12.22 |
| 15 | 14.09 | 16.89 | 16.19 | 13.90 | 12.50 | 16.16 | 14.58 | 15.41 | 13 16 | 15.79 | 13.09 |
| 16 | 15.02 | 18.02 | 17.27 | 14.83 | 13.33 | 17.24 | 15.55 | 16.44 | 14.04 | 16.84 | 13.96 |
| 17 | 15.96 | 19.14 | 18.35 | 15.75 | 14.17 | 18.31 | 16.52 | 17.46 | 14.91 | 17.89 | 14.83 |
| 18 | 16.90 | 20.27 | 19.43 | 16.68 | 15.00 | 19.39 | 17.49 | 18.49 | 15 79 | 18.95 | 15.70 |
| 19 | 17.84 | 21.39 | 20.51 | 17.61 | 15.84 | 20.47 | 18.46 | 19.52 | 16.67 | 20.00 | 16.58 |
| 20 | 18.78 | 22.52 | 21.58 | 18.54 | 16.67 | 21.54 | 19.43 | 20.55 | 17.54 | 21.05 | 17.45 |
| 21 | 19.72 | 23.64 | 22.66 | 19.46 | 17.50 | 22.62 | 20.40 | 21.57 | 18.42 | 22.11 | 18.33 |
| 22 | 20.66 | 24.77 | 23.74 | 20.39 | 18.33 | 23.69 | 21.37 | 22.59 | 19 30 | 23.16 | 19.20 |
| 23 | 21.60 | 25.90 | 24.82 | 21.31 | 19.17 | 24.77 | 22.34 | 23.62 | 20.18 | 24.21 | 20.07 |
| 24 | 22.54 | 27.02 | 25.90 | 22.24 | 20.00 | 25.85 | 23.31 | 24.65 | 21.05 | 25.26 | 20.94 |
| 25 | 23.47 | 28.15 | 26.98 | 23.17 | 20.83 | 26.93 | 24.29 | 25.68 | 21.93 | 26.32 | 21.82 |
| 26 | 24.41 | 29.27 | 28.05 | 24.09 | 21.67 | 28.00 | 25.26 | 26.70 | 22.81 | 27.37 | 22.69 |
| 27 | 25.35 | 30.40 | 29.13 | 25.02 | 22.50 | 29.08 | 26.23 | 27.73 | 23.69 | 28.42 | 23.56 |
| 28 | 26.29 | 31.53 | 30.21 | 25.95 | 23.33 | 30.16 | 27.20 | 28.76 | 24.57 | 29.47 | 24.44 |
| 29 | 27.23 | 32.66 | 31.29 | 26.87 | 24.17 | 31.23 | 28.17 | 29.78 | 25.44 | 30.52 | 25.31 |
| 30 | 28.17 | 33.78 | 32.37 | 27.80 | 25.00 | 32.31 | 29.14 | 30.81 | 26.32 | 31.58 | 26.18 |
| 31 | 29.11 | 34.90 | 33.45 | 28.73 | 25.83 | 33.39 | 30.11 | 31.84 | 27.19 | 32.63 | 27.05 |
| 32 | 30.05 | 36.03 | 34.53 | 29.65 | 26.67 | 34.47 | 31.08 | 32.86 | 28.07 | 33.68 | 27.93 |
| 33 | 30.99 | 37.15 | 35.61 | 30.58 | 27.50 | 35.54 | 32.06 | 33.89 | 28.95 | 34.74 | 28.80 |
| 34 | 31.93 | 38.28 | 36.69 | 31.51 | 28.33 | 36.62 | 33.03 | 34.92 | 29.82 | 35.79 | 29.67 |
| 35 | 32.87 | 39.40 | 37.77 | 32.43 | 29.17 | 37.69 | 34.00 | 35.95 | 30.70 | 36.84 | 30.54 |
| 36 | 33.80 | 40.53 | 38.84 | 33.36 | 30.00 | 38.77 | 34.97 | 36.97 | 31.58 | 37 89 | 31.42 |
| 37 | 34.74 | 41.65 | 39.92 | 34.29 | 30.84 | 39.85 | 35.94 | 38.00 | 32.46 | 38.95 | 32.29 |
| 38 | 35.68 | 42.78 | 41.00 | 35.21 | 31 67 | 40.93 | 36.92 | 39.03 | 33.33 | 40.00 | 33.16 |
| 39 | 36.62 | 43.90 | 42.08 | 36.14 | 32.50 | 42.00 | 37.89 | 40.05 | 34.21 | 41.05 | 34.04 |
| 40 | 37.56 | 45.03 | 43.16 | 37.07 | 33.33 | 43.08 | 38.86 | 41.08 | 35.09 | 42.11 | 34.91 |
| 41 | 38.50 | 46.16 | 44.24 | 37.99 | 34.17 | 44.16 | 39.83 | 42.11 | 35.97 | 43.16 | 35.78 |
| 42 | 39.44 | 47.29 | 45.32 | 38.92 | 35.00 | 45.24 | 40.80 | 43.14 | 36.84 | 44.21 | 36.65 |
| 43 | 40.38 | 48.42 | 46.40 | 39.84 | 35.83 | 46.31 | 41.77 | 44 16 | 37.72 | 45.26 | 37.53 |
| 44 | 41.32 | 49.54 | 47.48 | 40.77 | 36.67 | 47.39 | 42.75 | 45.19 | 38.60 | 46.32 | 38.40 |
| 45 | 42.26 | 50.67 | 48.55 | 41.70 | 37.50 | 48.47 | 43.71 | 46.22 | 39.47 | 47.37 | 39.27 |
| 46 | 43.19 | 51.79 | 49.63 | 42.63 | 38.33 | 49.54 | 44.69 | 47.25 | 40.35 | 48.42 | 40.14 |
| 47 | 44.13 | 52.92 | 50.71 | 43.55 | 39.17 | 50.62 | 45.66 | 48.27 | 41.23 | 49.47 | 41.02 |
| 48 | 45.07 | 54.05 | 51.79 | 44.48 | 40.00 | 51.69 | 46.63 | 49.30 | 42.11 | 50.52 | 41.89 |
| 49 | 46.01 | 55.17 | 52.87 | 45.41 | 40.83 | 52.77 | 47.60 | 50.33 | 42.98 | 51.58 | 42.76 |
| 50 | 46.95 | 56.30 | 53.95 | 46.34 | 41.67 | 53.85 | 48.58 | 51.36 | 43.86 | 52.63 | 43.64 |
| 51 | 47.89 | 57.43 | 55.03 | 47.26 | 42.50 | 54.93 | 49.55 | 52.38 | 44.74 | 53.68 | 44.51 |
| 52 | 48.83 | 58.55 | 56.11 | 48.19 | 43.33 | 56.00 | 50.52 | 53.41 | 45.61 | 54.74 | 45.38 |
| 53 | 49.77 | 59.68 | 57.19 | 49.12 | 44.17 | 57.08 | 51.49 | 54.44 | 46.49 | 55.79 | 46.25 |
| 54 | 50.71 | 60.81 | 58.27 | 50.04 | 45.00 | 58.16 | 52.46 | 55.46 | 47.37 | 56.84 | 47.13 |
| 55 | 51.65 | 61.93 | 59.35 | 50.97 | 45.83 | 59.24 | 53.43 | 56.49 | 48.25 | 57.89 | 48.00 |
| 56 | 52.58 | 63.06 | 60.43 | 51.90 | 46.67 | 60.31 | 54.40 | 57.52 | 49.12 | 58.95 | 48.87 |
| 57 | 53.52 | 64.19 | 61.51 | 52.82 | 47.50 | 61.39 | 55.37 | 58.55 | 50.00 | 60.00 | 49.75 |
| 58 | 54.46 | 65.31 | 62.58 | 53.75 | 48.33 | 62.47 | 56.34 | 59.57 | 50.88 | 61.05 | 50.62 |
| 59 | 55.40 | 66.44 | 63.66 | 54.68 | 49.17 | 63.54 | 57.31 | 60.59 | 51.75 | 62.11 | 51.49 |
| 60 | 56.34 | 67.57 | 64.74 | 55.60 | 50.00 | 64.62 | 58.29 | 61.62 | 52.63 | 63.16 | 52.36 |

# TABLE LIII.

## For converting Foreign Measures into English feet or fathoms, and the contrary.

| English feet. | French feet. | | Spanish feet. | Portuguese feet. | | Amsterdam feet. | Rynland feet. | Swedish feet. | Venetian feet. | | Russian feet. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English fathoms | French toises. | French brasses. | Spanish brazas. | | Portuguese braças. | | | Swedish fathoms | | Venetian passi. | |
| 61 | 57.28 | 68.68 | 65.82 | 56.54 | 50.83 | 65.69 | 59.26 | 62.65 | 53.51 | 64.21 | 53.24 |
| 62 | 58.22 | 69.81 | 66.90 | 57.46 | 51.67 | 66.77 | 60.23 | 63.68 | 54.39 | 65.26 | 54.11 |
| 63 | 59.16 | 70.94 | 67.98 | 58.39 | 52.50 | 67.85 | 61.20 | 64.70 | 55.26 | 66.32 | 54.98 |
| 64 | 60.10 | 72.06 | 69.05 | 59.31 | 53.33 | 68.93 | 62.17 | 65.73 | 56.14 | 67.37 | 55.85 |
| 65 | 61.04 | 73.19 | 70.13 | 60.24 | 54.17 | 70.00 | 63.14 | 66.76 | 57.02 | 68.42 | 56.73 |
| 66 | 61.97 | 74.31 | 71.21 | 61.17 | 55.00 | 71.08 | 64.11 | 67.78 | 57.90 | 69.47 | 57.60 |
| 67 | 62.91 | 75.14 | 72.29 | 62.09 | 55.83 | 72.16 | 65.08 | 68.81 | 58.77 | 70.52 | 58.47 |
| 68 | 63.85 | 76.57 | 73.37 | 63.02 | 56.67 | 73.24 | 66.06 | 69.84 | 59.65 | 71.58 | 59.35 |
| 69 | 64.79 | 77.69 | 74.45 | 63.95 | 57.50 | 74.31 | 67.03 | 70.86 | 60.53 | 72.63 | 60.22 |
| 70 | 65.73 | 78.82 | 75.53 | 64.87 | 58.33 | 75.39 | 68.00 | 71.89 | 61.40 | 73.68 | 61.09 |
| 71 | 66.67 | 79.95 | 76.61 | 65.80 | 59.17 | 76.47 | 68.97 | 72.92 | 62.28 | 74.74 | 61.96 |
| 72 | 67.61 | 81.08 | 77.69 | 66.73 | 60.00 | 77.54 | 69.94 | 73.95 | 63.16 | 75.79 | 62.83 |
| 73 | 68.55 | 82.21 | 78.77 | 67.65 | 60.83 | 78.62 | 70.92 | 74.97 | 64.04 | 76.84 | 63.70 |
| 74 | 69.49 | 83.33 | 79.84 | 68.58 | 61.67 | 79.69 | 71.89 | 76.00 | 64.91 | 77.89 | 64.58 |
| 75 | 70.43 | 84.46 | 80.92 | 69.51 | 62.50 | 80.77 | 72.86 | 77.03 | 65.79 | 78.95 | 65.45 |
| 76 | 71.36 | 85.59 | 82.00 | 70.43 | 63.33 | 81.85 | 73.83 | 78.05 | 66.67 | 80.00 | 66.32 |
| 77 | 72.30 | 86.71 | 83.08 | 71.36 | 64.17 | 82.93 | 74.80 | 79.08 | 67.54 | 81.05 | 67.20 |
| 78 | 73.24 | 87.84 | 84.16 | 72.29 | 65.00 | 84.00 | 75.77 | 80.11 | 68.42 | 82.11 | 68.07 |
| 79 | 74.18 | 88.97 | 85.24 | 73.21 | 65.83 | 85.08 | 76.75 | 81.14 | 69.30 | 83.16 | 68.94 |
| 80 | 75.12 | 90.10 | 86.32 | 74.14 | 66.67 | 86.16 | 77.71 | 82.16 | 70.18 | 84.21 | 69.82 |
| 81 | 76.06 | 91.22 | 87.40 | 75.07 | 67.50 | 87.24 | 78.69 | 83.19 | 71.05 | 85.26 | 70.69 |
| 82 | 77.00 | 92.35 | 88.48 | 75.99 | 68.33 | 88.31 | 79.66 | 84.22 | 71.93 | 86.32 | 71.56 |
| 83 | 77.94 | 93.47 | 89.55 | 76.93 | 69.17 | 89.39 | 80.63 | 85.25 | 72.81 | 87.37 | 72.44 |
| 84 | 78.88 | 94.60 | 90.63 | 77.85 | 70.00 | 90.47 | 81.60 | 86.27 | 73.69 | 88.42 | 73.31 |
| 85 | 79.82 | 95.73 | 91.71 | 78.78 | 70.83 | 91.54 | 82.58 | 87.30 | 74.57 | 89.47 | 74.18 |
| 86 | 80.76 | 96.86 | 92.79 | 79.71 | 71.67 | 92.62 | 83.55 | 88.33 | 75.44 | 90.52 | 75.05 |
| 87 | 81.70 | 97.98 | 93.87 | 80.63 | 72.50 | 93.69 | 84.52 | 89.36 | 76.32 | 91.58 | 75.93 |
| 88 | 82.63 | 99.10 | 94.95 | 81.56 | 73.33 | 94.77 | 85.49 | 90.38 | 77.19 | 92.63 | 76.80 |
| 89 | 83.57 | 100.23 | 96.03 | 82.49 | 74.17 | 95.85 | 86.46 | 91.41 | 78.07 | 93.68 | 77.67 |
| 90 | 84.51 | 101.35 | 97.11 | 83.41 | 75.00 | 96.93 | 87.43 | 92.44 | 78.95 | 94.74 | 78.54 |
| 91 | 85.45 | 102.46 | 98.19 | 84.34 | 75.83 | 98.00 | 88.40 | 93.46 | 79.82 | 95.79 | 79.42 |
| 92 | 86.39 | 103.59 | 99.27 | 85.27 | 76.67 | 99.08 | 89.37 | 94.49 | 80.70 | 96.84 | 80.29 |
| 93 | 87.33 | 104.72 | 100.35 | 86.20 | 77.50 | 100.16 | 90.34 | 95.52 | 81.58 | 97.89 | 81.16 |
| 94 | 88.27 | 105.84 | 101.43 | 87.12 | 78.33 | 101.24 | 91.31 | 96.55 | 82.46 | 98.95 | 82.04 |
| 95 | 89.21 | 106.97 | 102.51 | 88.05 | 79.17 | 102.31 | 92.29 | 97.57 | 83.33 | 100.00 | 82 91 |
| 96 | 90.15 | 108.09 | 103.58 | 88.97 | 80.00 | 103.39 | 93.26 | 98.59 | 84.21 | 101.05 | 83.78 |
| 97 | 91.09 | 109.22 | 104.66 | 89.90 | 80.83 | 104.47 | 94.23 | 99.62 | 85.09 | 102.11 | 84.65 |
| 98 | 92.02 | 110.35 | 105.74 | 90.83 | 81.67 | 105.54 | 95.20 | 100.65 | 85.97 | 103.16 | 85.53 |
| 99 | 92.96 | 111.47 | 106.82 | 91.75 | 82.50 | 106.62 | 96.17 | 101.68 | 86.84 | 104.21 | 86.40 |
| 100 | 93.90 | 112.59 | 107.90 | 92.68 | 83.33 | 107.69 | 97.14 | 102.70 | 87.72 | 105.26 | 87.27 |
| 101 | 94.84 | 113.72 | 108.98 | 93.61 | 84.17 | 108.77 | 98.11 | 103.73 | 88.60 | 106.32 | 88.14 |
| 102 | 95.78 | 114.85 | 110.05 | 94.54 | 85.00 | 109.85 | 99.08 | 104.76 | 89.47 | 107.37 | 89.02 |
| 103 | 96.72 | 115 97 | 111.13 | 95.46 | 85.83 | 110.93 | 100.06 | 105.78 | 90.35 | 108.42 | 89.89 |
| 104 | 97.66 | 117.10 | 112.21 | 96.39 | 86.67 | 112.00 | 101.03 | 106.81 | 91.23 | 109.47 | 90.76 |
| 105 | 98.60 | 118.23 | 113.29 | 97.31 | 87.50 | 113.08 | 102.00 | 107.84 | 92.11 | 110.52 | 91.64 |
| 106 | 99.54 | 119.35 | 114.37 | 98.24 | 88.33 | 114.16 | 102.97 | 108.86 | 92.98 | 111.58 | 92.51 |
| 107 | 100.47 | 120.48 | 115.45 | 99.17 | 89.17 | 115.24 | 103.94 | 109.89 | 93.86 | 112.63 | 93 38 |
| 108 | 101.41 | 121.60 | 116.53 | 100.09 | 90.00 | 116.31 | 104.92 | 110.92 | 94.74 | 113 68 | 94.25 |
| 109 | 102.35 | 122.72 | 117.61 | 101.02 | 90.83 | 117.39 | 105.89 | 111.95 | 95.61 | 114.74 | 95 13 |
| 110 | 103.29 | 123.85 | 118.69 | 101.95 | 91.67 | 118.47 | 106.86 | 112.97 | 96.49 | 115.79 | 96.00 |
| 111 | 104.23 | 124.98 | 119.77 | 102.87 | 92.50 | 119.54 | 107.83 | 114.00 | 97.37 | 116.84 | 96.87 |
| 112 | 105.17 | 126 11 | 120.84 | 103.80 | 93.33 | 120.62 | 108.80 | 115.03 | 98.25 | 117.89 | 97 75 |
| 113 | 106.11 | 127.23 | 121.92 | 104.73 | 94.17 | 121.69 | 109.77 | 116.05 | 99.12 | 118.95 | 98.62 |
| 114 | 107.05 | 128.36 | 123.00 | 105.65 | 95.00 | 122.77 | 110.75 | 117.08 | 100.00 | 120.00 | 99.49 |
| 115 | 107.99 | 129.48 | 124.08 | 106.58 | 95.83 | 123.85 | 111.71 | 118.11 | 100.88 | 121.05 | 100.36 |
| 116 | 108.93 | 130.61 | 125.16 | 107.51 | 96.67 | 124.93 | 112.69 | 119.14 | 101.75 | 122.11 | 101.24 |
| 117 | 109.87 | 131.74 | 126.24 | 108.43 | 97.50 | 126.00 | 113 66 | 120.16 | 102.63 | 123.16 | 102.11 |
| 118 | 110.80 | 132.87 | 127.32 | 109.36 | 98.33 | 127.08 | 114.63 | 121.19 | 103.51 | 124.21 | 102.98 |
| 119 | 111.74 | 134.00 | 128.40 | 110.29 | 99.17 | 128.16 | 115.60 | 122.22 | 104.39 | 125.26 | 103.85 |
| 120 | 112.68 | 135.14 | 129.48 | 111.21 | 100.00 | 129.24 | 116.58 | 123.25 | 105.26 | 126.32 | 104.73 |

## TABLE LIV.

### For finding the exact GREENWICH TIME, corresponding to the true LUNAR DISTANCE.

| Approximate Interval. | | Difference of the proportional Logarithm in the Almanac. | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| h. m. | h. m. | s | s | s | s | s | s | s | s | s | s | s | s | s | s | s | s | s | s | s |
| 0 0 | 3 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 10 | 2 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 6 |
| 0 20 | 2 40 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | 12 |
| 0 30 | 2 30 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 5 | 7 | 9 | 10 | 12 | 14 | 16 | 17 |
| 0 40 | 2 20 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 4 | 6 | 9 | 11 | 13 | 15 | 17 | 9 | 21 |
| 0 50 | 2 10 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 5 | 7 | 10 | 13 | 15 | 17 | 20 | 23 | 25 |
| 1 0 | 2 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 6 | 8 | 11 | 14 | 17 | 19 | 22 | 25 | 28 |
| 1 10 | 1 50 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 |
| 1 20 | 1 40 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 6 | 9 | 12 | 15 | 19 | 21 | 25 | 28 | 31 |
| 1 30 | 1 30 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 6 | 9 | 12 | 16 | 19 | 22 | 25 | 28 | 31 |

## TABLE LV.

### To reduce the Moon's HORIZONTAL PARALLAX and SEMIDIAMETER to any Time under the Meridian of Greenwich.

| Diff. in 12 Hours | Greenwich Time after Noon or Midnight. | | | | | | | | | | | | | | | | | | | | | Diff. in 12 Hours |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | h. m. 0 10 | h. m. 0 20 | h. m. 0 30 | h. m. 0 40 | h. m. 0 50 | h. m. 1 0 | h. m. 2 0 | h. m. 3 0 | h. m. 4 0 | h. m. 5 0 | h. m. 6 0 | h. m. 7 0 | h. m. 8 0 | h. m. 9 0 | h. m. 10 0 | h. m. 11 0 | | | | | | |
| 1″ | 0″ | 0″ | 0′ | 0″ | 0″ | 0″ | 0″ | 0″ | 0″ | 0″ | 0″ | 1″ | 1′ | 1′ | 1′ | 1″ | 1″ | | | | | |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | | | | | |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | | | | | |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | | | | | |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | | | | | |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 6 | | | | | |
| 7 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 6 | 7 | | | | | |
| 8 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | | | | | |
| 9 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | | | | | |
| 10 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | | | | | |
| 11 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | | | |
| 12 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | | |
| 13 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | | | | | |
| 14 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 11 | 12 | 13 | 14 | | | | | |
| 15 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | 13 | 14 | 15 | | | | | |
| 16 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 11 | 12 | 13 | 15 | 16 | | | | | |
| 17 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | 4 | 6 | 7 | 8 | 10 | 11 | 13 | 14 | 16 | 17 | | | | | |
| 18 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | 4 | 6 | 7 | 9 | 11 | 12 | 14 | 15 | 17 | 18 | | | | | |
| 19 | 0 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 13 | 14 | 16 | 17 | 19 | | | | | |
| 20 | 0 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 7 | 8 | 10 | 12 | 13 | 15 | 17 | 18 | 20 | | | | | |
| 21 | 0 | 1 | 1 | 1 | 2 | 2 | 3 | 5 | 7 | 9 | 10 | 12 | 14 | 16 | 18 | 19 | 21 | | | | | |
| 22 | 0 | 1 | 1 | 1 | 2 | 2 | 4 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 18 | 20 | 22 | | | | | |
| 23 | 0 | 1 | 1 | 1 | 2 | 2 | 4 | 6 | 8 | 10 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | | | | | |
| 24 | 0 | 1 | 1 | 1 | 2 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | | | | | |
| 25 | 0 | 1 | 1 | 1 | 2 | 2 | 4 | 6 | 8 | 10 | 12 | 15 | 17 | 19 | 21 | 23 | 25 | | | | | |
| 26 | 0 | 1 | 1 | 1 | 2 | 2 | 4 | 6 | 9 | 11 | 13 | 15 | 17 | 20 | 22 | 24 | 26 | | | | | |
| 27 | 0 | 1 | 1 | 1 | 2 | 2 | 4 | 7 | 9 | 11 | 13 | 16 | 18 | 20 | 23 | 25 | 27 | | | | | |
| 28 | 0 | 1 | 1 | 2 | 2 | 2 | 5 | 7 | 9 | 12 | 14 | 16 | 19 | 21 | 23 | 26 | 28 | | | | | |
| 29 | 0 | 1 | 1 | 2 | 2 | 2 | 5 | 7 | 10 | 12 | 14 | 17 | 19 | 22 | 24 | 27 | 29 | | | | | |
| 30 | 0 | 1 | 1 | 2 | 2 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | 23 | 25 | 28 | 30 | | | | | |

# TABLE LVI.

## LATITUDES AND LONGITUDES

Of the principal Ports, Harbours, Capes, Shoals, Rocks, &c. in the WORLD, founded on several thousand Observations made by the most eminent ASTRONOMERS and NAVIGATORS, compared with the latest and most accurate CHARTS and SURVEYS; to which is occasionally added the Variation of the Compass.

*The Longitudes are reckoned from the Meridian of Greenwich.*

| | I. Coast of GREAT BRITAIN, and adjacent Islands. (1) Places. | Lat. N. | Lon. W. |
|---|---|---|---|
| | | ° ′ ″ | ° ′ ″ |
| South Coast of England. | LONDON, St. Paul's | 51 30 49 | 0 5 47 |
| | *Var.* 24° 9′, 1824. | | |
| | GREENWICH Obs. . | 51 28 39 | 0 0 0 |
| | | | East |
| | Gravesend Church | 51 27 39 | 0 22 10 |
| | Sheerness Flag Staff | 51 26 45 | 0 44 26 |
| | *Var.* 24° 30′ *W.* 1822. | | |
| | N. Foreland Light | 51 22 25 | 1 26 34 |
| | Deal Castle . . . | 51 13 5 | 1 23 59 |
| | S. Foreland Up. Light | 51 8 26 | 1 22 6 |
| | Dover Castle . . | 51 7 47 | 1 19 7 |
| | Folkstone Church . | 51 4 47 | 1 10 52 |
| | New Romney Church | 50 59 7 | 0 56 22 |
| | Lydd Church . . | 50 57 7 | 0 54 19 |
| | Dungeness Light . | 50 55 1 | 0 57 48 |
| | Rye Church . . | 50 57 1 | 0 44 0 |
| | Hastings . . . | 50 52 10 | 0 38 0 |
| | Beachy Hd. (Station) | 50 44 24 | 0 15 12 |
| | | | West |
| | Brighton Church . | 50 49 32 | 0 7 40 |
| | Shoreham Church | 50 50 0 | 0 16 19 |
| | Owers Light . . | 50 39 57 | 0 39 59 |
| | Selsea Church . . | 50 45 19 | 0 45 41 |
| | Chichester Church | 50 50 11 | 0 46 36 |
| | PORTSMOUTH Church | 50 47 27 | 1 5 57 |
| | — Academy . . | 50 48 4 | 1 5 59 |
| | *Var.* 24° 15′ *W.* 1813. | | |
| | South-Sea Castle . | 50 46 44 | 1 5 2 |
| | Calshot Castle . . | 50 49 7 | 1 18 6 |
| I. of Wight. | Cowes . . . . | 50 45 37 | 1 16 15 |
| | Bembridge Point . | 50 40 59 | 1 4 51 |
| | Dunnose (Station) | 50 37 9 | 1 11 36 |
| | St. Catherine's Tower | 50 35 34 | 1 17 51 |
| | Needles Light . . | 50 39 54 | 1 33 55 |
| South Coast of England. | Hurst Castle . . | 50 42 25 | 1 32 45 |
| | Christ-Church Head | 50 42 38 | 1 44 31 |
| | Poole Church . . | 50 42 51 | 1 58 55 |
| | St. Aldan's Head . | 50 35 0 | 2 3 20 |
| | Weymouth . . . | 50 36 0 | 2 27 0 |
| | Portland Up. Light | 50 31 23 | 2 26 49 |
| | Bridport . . . . | 50 42 20 | 2 43 30 |
| | Lyme Cobb . . | 50 43 11 | 2 55 29 |
| | Exmouth Bar . . | 50 36 40 | 3 21 30 |
| | Torbay, Bob's Nose | 50 27 50 | 3 26 43 |
| | — Berry Head . | 50 24 2 | 3 28 14 |
| | Dartmouth . . . | 50 19 40 | 3 35 30 |
| | Start Point, flagstaff | 50 13 27 | 3 38 21 |
| | Praule Point . . | 50 13 15 | 3 42 30 |
| | Bolt Head (Station) | 50 13 45 | 3 48 3 |

| (2) Places. | Lat. N. | Lon. W. |
|---|---|---|
| | ° ′ ″ | ° ′ ″ |
| Eddystone Light . | 50 10 54 | 4 15 3 |
| Mewstone . . . | 50 18 30 | 4 5 33 |
| PLYMOUTH, New Ch. | 50 22 21 | 4 7 16 |
| — Old Church . | 50 22 15 | 4 7 32 |
| Drake's Island . . | 50 22 4 | 4 8 18 |
| Penlee Beacon . | 50 19 25 | 4 10 40 |
| Rame Head (flagstaff) | 50 18 53 | 4 12 29 |
| Fowey . . . . | 50 20 7 | 4 37 31 |
| Deadman's Pt. (flag.) | 50 13 21 | 4 47 4 |
| FALMOUTH, | | |
| — St. Anthony's Hd. | 50 8 35 | 4 59 31 |
| — Pendennis Castle | 50 8 50 | 5 1 44 |
| Blackhead, flagstaff | 50 1 13 | 5 3 59 |
| LIZARD upper Light | 49 57 41 | 5 11 5 |
| Mount's Bay . . | | |
| — St. Michael's Mt. | 50 7 2 | 5 27 33 |
| — St. Paul's Steeple | 50 5 26 | 5 31 37 |
| St. Leven's Point . | 50 3 54 | 5 41 4 |
| Rundlestone Beacon | 50 1 30 | 5 39 0 |
| Wolf Rock . . . | 49 55 45 | 5 48 0 |
| Longship's Light . | 50 4 2 | 5 43 33 |
| Land's End Stone | 50 4 8 | 5 41 31 |
| Scilly Islands, | | |
| — St. Agnes' Light | 49 53 37 | 6 19 23 |
| — St. Mary's Fort | 49 55 0 | 6 17 57 |
| — St. Martin's D.Mk. | 49 58 4 | 6 14 39 |
| *Var.* 27° 30′ W. 1814. | | |
| The Seven Stones | 50 2 30 | 6 6 0 |
| Cape Cornwall . | 50 8 0 | 5 41 0 |
| St. Ives . . . . | 50 13 0 | 5 28 0 |
| St. Agnes Beacon . | 50 18 27 | 5 11 56 |
| Trevose Head . . | 50 32 57 | 5 0 54 |
| Padstow . . . . | 50 35 0 | 4 55 0 |
| Tintagel Head . . | 50 40 0 | 4 45 0 |
| Hartland Point . | 51 1 22 | 4 30 26 |
| Mort Point . . . | 51 11 0 | 4 13 0 |
| Lundy I. Light . | 51 10 5 | 4 39 20 |
| Flatholm Light . | 51 22 33 | 3 6 25 |
| Bridgewater Church | 51 7 41 | 2 59 39 |
| BRISTOL Cathedral | 51 27 6 | 2 35 29 |
| Nash Point . . . | 51 24 30 | 3 33 0 |
| Mumbles Pt. and Lt. | 51 34 0 | 3 57 20 |
| Worms Head . . | 51 33 56 | 4 18 56 |
| Pembrey Church . | 51 41 18 | 4 15 28 |
| Caldy Island . . | 51 37 0 | 4 40 0 |
| St. Gowan's Point | 51 36 0 | 4 56 0 |
| St. Ann's Light . | 51 40 59 | 5 9 19 |
| Milford Church . | 51 42 43 | 5 0 39 |
| Hubberstone Church | 51 42 56 | 5 2 7 |
| Smalls Light . . | 51 43 18 | 5 38 54 |
| Grasholm . . . | 51 43 55 | 5 27 32 |
| Ramsey Isle . . | 51 51 43 | 5 19 36 |
| St. David's Cathedral | 51 52 56 | 5 14 53 |



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## LATITUDES AND LONGITUDES.

| (3) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *West Coast of England.* | | | | | | |
| Bishop and Clerks | 51 | 54 | 10 | 5 | 21 | 58 |
| Strumble Head | 52 | 1 | 30 | 5 | 6 | 0 |
| Dinas Point | 52 | 2 | 0 | 4 | 53 | 0 |
| Cardigan Harbour | 52 | 7 | 0 | 4 | 42 | 0 |
| Aberistwith | 52 | 25 | 0 | 4 | 6 | 0 |
| Barmouth, entr. | 52 | 44 | 0 | 4 | 5 | 0 |
| Bardsey I. Light | 52 | 46 | 0 | 4 | 46 | 0 |
| Brachy Pool Head | 52 | 48 | 0 | 4 | 45 | 0 |
| Holyhead Island, — Signal Tower | 53 | 19 | 6 | 4 | 39 | 30 |
| Skerries Light | 53 | 25 | 0 | 4 | 37 | 0 |
| Point Linas, Light | 53 | 25 | 0 | 4 | 17 | 0 |
| Great Ormes Head | 53 | 20 | 2 | 3 | 50 | 21 |
| Point of Air Light | 53 | 21 | 28 | 3 | 18 | 35 |
| Helbre Light | 53 | 23 | 34 | 3 | 10 | 13 |
| Leasows Light | 53 | 24 | 50 | 3 | 6 | 49 |
| LIVERPOOL, St. Paul's | 53 | 24 | 40 | 2 | 58 | 55 |
| Formby Point | 53 | 32 | 34 | 3 | 5 | 2 |
| Lancaster Church | 54 | 3 | 8 | 2 | 47 | 41 |
| St. Bees Head Light | 54 | 30 | 55 | 3 | 37 | 24 |
| Whitehaven | 54 | 32 | 50 | 3 | 34 | 56 |
| CARLISLE | 54 | 56 | 0 | 2 | 54 | 0 |
| Annan Church | 54 | 59 | 23 | 3 | 14 | 45 |
| *Isle of Man.* | | | | | | |
| Air Point Light | 54 | 26 | 0 | 4 | 23 | 0 |
| Douglas | 54 | 9 | 30 | 4 | 29 | 0 |
| Castletown | 54 | 5 | 0 | 4 | 39 | 0 |
| The Calf Light | 54 | 2 | 30 | 4 | 48 | 0 |
| Peele Light | 54 | 13 | 30 | 4 | 41 | 0 |
| *West and North Coasts of Scotland.* | | | | | | |
| Ross Head | 54 | 47 | 0 | 4 | 6 | 0 |
| Burrow Head | 54 | 41 | 0 | 4 | 24 | 0 |
| Mull of Galloway | 54 | 38 | 30 | 4 | 52 | 0 |
| Port Patrick Light | 54 | 49 | 0 | 5 | 5 | 0 |
| Lough Ryan, entr. | 55 | 3 | 0 | 5 | 6 | 0 |
| Air Lights | 55 | 28 | 30 | 4 | 37 | 0 |
| Irvine | 55 | 38 | 0 | 4 | 38 | 0 |
| Ailsa Island | 55 | 17 | 0 | 5 | 8 | 0 |
| Cumray I. Light | 55 | 45 | 0 | 4 | 54 | 0 |
| Greenock | 55 | 57 | 0 | 4 | 44 | 30 |
| GLASGOW | 55 | 51 | 32 | 4 | 16 | 0 |
| Pladda Light | 55 | 32 | 0 | 5 | 4 | 0 |
| Mull of Cantire Light | 55 | 19 | 30 | 5 | 43 | 0 |
| Tonvore Head | 55 | 54 | 0 | 6 | 28 | 0 |
| Runs Point Light | 55 | 46 | 0 | 6 | 28 | 0 |
| Skerryvore Rocks | 56 | 17 | 0 | 7 | 1 | 0 |
| Dusker Rock | 56 | 34 | 0 | 6 | 58 | 0 |
| Coll Island, N. end | 56 | 42 | 0 | 6 | 24 | 0 |
| Rum Island, S. end | 56 | 55 | 0 | 6 | 15 | 0 |
| Helsker Island | 56 | 56 | 0 | 6 | 38 | 0 |
| Dunvegan Head | 57 | 30 | 0 | 6 | 43 | 0 |
| Rea Head | 57 | 50 | 0 | 5 | 43 | 0 |
| More Head | 58 | 5 | 0 | 5 | 19 | 0 |
| Stower Head | 58 | 14 | 0 | 5 | 18 | 0 |
| Cape Wrath Light *Var.* 30° *W.* | 58 | 38 | 30 | 4 | 57 | 0 |
| Nun Rock | 58 | 52 | 30 | 4 | 56 | 0 |
| Rona Island | 58 | 59 | 30 | 5 | 53 | 30 |
| Barra Island | 58 | 58 | 0 | 6 | 3 | 0 |
| Fareut Head | 58 | 37 | 30 | 4 | 47 | 0 |
| Dunnet Head | 58 | 42 | 0 | 3 | 26 | 0 |

| (4) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Duncansby Head *Var.* 30° *W.* | 58 | 39 | 45 | 3 | 6 | 20 |
| *Hebrides or Lewis Isl.* | | | | | | |
| Barra Head | 56 | 47 | 0 | 7 | 38 | 0 |
| South Ulst, S. end | 57 | 4 | 0 | 7 | 14 | 0 |
| Renish Head | 57 | 41 | 0 | 6 | 57 | 0 |
| Glash I. Light | 57 | 50 | 0 | 6 | 37 | 0 |
| Aird, N. Point | 58 | 15 | 0 | 6 | 5 | 0 |
| Butt of Lewis | 58 | 31 | 0 | 6 | 13 | 30 |
| Gallen Head | 58 | 11 | 0 | 7 | 4 | 0 |
| Flannen Isles | 58 | 18 | 0 | 7 | 31 | 0 |
| St. Kilda | 57 | 49 | 30 | 8 | 32 | 30 |
| Hyskar Island | 57 | 38 | 0 | 7 | 41 | 0 |
| Rockall | 57 | 39 | 32 | 13 | 31 | 16 |
| *Orkney Islands.* | | | | | | |
| Pentland Skerries, Lts. | 58 | 42 | 0 | 3 | 2 | 0 |
| Stroma Isle, S. end | 58 | 41 | 0 | 3 | 14 | 0 |
| S. Ronaldsha, Old Hd. | 58 | 44 | 30 | 3 | 1 | 20 |
| Copinsha | 58 | 55 | 20 | 2 | 46 | 0 |
| Kirkwall Road | 58 | 59 | 0 | 3 | 4 | 0 |
| Stronsa I., Lamb Head | 59 | 4 | 0 | 2 | 39 | 0 |
| Start Point Light | 59 | 16 | 30 | 2 | 22 | 0 |
| North Ronaldsha, — Dennisness | 59 | 22 | 30 | 2 | 22 | 0 |
| Papa Westra Isle, — Moul head | 59 | 21 | 0 | 3 | 3 | 0 |
| Westra I., Noup Head | 59 | 18 | 30 | 3 | 12 | 0 |
| Pomona Island, — Marwick Head | 59 | 6 | 0 | 3 | 25 | 0 |
| — Stromness, town *Var.* 27° 50′ *W.* 1821. | 58 | 56 | 56 | 3 | 24 | 0 |
| Hoy Head | 58 | 55 | 0 | 3 | 28 | 30 |
| Sule Skerry | 59 | 3 | 0 | 4 | 15 | 0 |
| Stack | 59 | 1 | 30 | 4 | 18 | 0 |
| Fair Island | 59 | 30 | 0 | 1 | 47 | 0 |
| *Shetland Islands.* | | | | | | |
| Sumbro Head Light | 59 | 51 | 40 | 1 | 27 | 30 |
| Hangcliff | 60 | 9 | 0 | 1 | 7 | 30 |
| LERWICK, Fort | 60 | 10 | 30 | 1 | 18 | 0 |
| Brassa I., S. Point | 60 | 7 | 0 | 1 | 15 | 30 |
| Rumble Island | 60 | 21 | 0 | 1 | 4 | 0 |
| Out Skerries | 60 | 29 | 30 | 0 | 56 | 0 |
| Balta | 60 | 45 | 0 | 1 | 9 | 30 |
| Lambaness *Var.* 27° 40′ *W.* | 60 | 48 | 0 | 1 | 9 | 30 |
| Ronas Hill | 60 | 33 | 0 | 1 | 45 | 0 |
| Ossa Skerry | 60 | 28 | 0 | 1 | 55 | 0 |
| Voe Skerries | 60 | 21 | 0 | 2 | 2 | 0 |
| Foul Island | 60 | 5 | 0 | 2 | 13 | 0 |
| *Faroe Islands.* | | | | | | |
| Monk Rock | 61 | 23 | 0 | 6 | 52 | 15 |
| Suderoe, S. end | 61 | 26 | 20 | 6 | 53 | 0 |
| Great Diamond | 61 | 44 | 0 | 6 | 53 | 30 |
| Sandoe, S. end | 61 | 47 | 15 | 6 | 48 | 0 |
| Stromoe, Thorshaven | 62 | 2 | 10 | 6 | 50 | 30 |
| Fugloe | 62 | 20 | 40 | 6 | 18 | 0 |
| Mygenas I. W. end *Var.* 30° *W.* 1818. | 62 | 8 | 0 | 7 | 42 | 30 |
| Noss Head | 58 | 30 | 0 | 3 | 9 | 0 |
| Clyth Ness | 58 | 20 | 0 | 3 | 16 | 0 |

## LATITUDES AND LONGITUDES.

East Coast of Scotland.

| (5) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Ord Head | 58 | 10 | 0 | 3 | 37 | 0 |
| Tarbett Ness | 57 | 54 | 0 | 3 | 47 | 0 |
| Cromartie | 57 | 42 | 0 | 4 | 1 | 0 |
| Inverness | 57 | 31 | 0 | 4 | 12 | 0 |
| Fort St. George | 57 | 37 | 0 | 4 | 5 | 0 |
| Burgh Head | 57 | 43 | 0 | 3 | 30 | 0 |
| Cousy Point | 57 | 44 | 0 | 3 | 17 | 0 |
| Cullen | 57 | 42 | 0 | 2 | 50 | 0 |
| Bamff | 57 | 40 | 0 | 2 | 32 | 0 |
| Kinnaird's Head | 57 | 41 | 40 | 2 | 1 | 0 |
| Ratrie Head | 57 | 38 | 0 | 1 | 50 | 0 |
| Peter Head | 57 | 32 | 0 | 1 | 47 | 0 |
| Buchan Ness Light | 57 | 29 | 15 | 1 | 47 | 0 |
| *Var.* 28° *W.* | | | | | | |
| Newburgh | 57 | 20 | 0 | 2 | 3 | 0 |
| New Aberdeen, obs. | 57 | 9 | 0 | 2 | 8 | 0 |
| Girdleness | 57 | 8 | 0 | 2 | 6 | 0 |
| Stonehaven | 56 | 58 | 0 | 2 | 13 | 0 |
| Tod Head | 56 | 53 | 0 | 2 | 15 | 0 |
| Montrose Ness | 56 | 42 | 10 | 2 | 27 | 15 |
| Red Head | 56 | 38 | 0 | 2 | 28 | 0 |
| Arbroath | 56 | 34 | 0 | 2 | 35 | 0 |
| Button Ness and Lts | 56 | 28 | 0 | 2 | 44 | 15 |
| Dundee | 56 | 28 | 0 | 2 | 57 | 30 |
| Inch Cape Light, or Bell Rock | 56 | 26 | 40 | 2 | 22 | 45 |
| St. Andrew's Church | 56 | 20 | 40 | 3 | 47 | 0 |
| Fife Ness | 56 | 17 | 0 | 2 | 34 | 30 |
| Elie Ness | 56 | 11 | 20 | 2 | 48 | 0 |
| Kinghorn Ness | 56 | 4 | 0 | 3 | 10 | 0 |
| Inchcolm | 56 | 2 | 0 | 3 | 17 | 0 |
| EDINBURGH, Coll. | 55 | 57 | 57 | 3 | 10 | 30 |
| Leith Pier | 55 | 58 | 50 | 3 | 10 | 0 |
| *Var.* 27° 45′ *W.* | | | | | | |
| Inch Keith Light | 56 | 2 | 15 | 3 | 7 | 30 |
| Fidra | 56 | 4 | 30 | 2 | 46 | 30 |
| North Berwick, Law | 56 | 3 | 8 | 2 | 42 | 11 |
| May I. and Light | 56 | 11 | 22 | 2 | 32 | 47 |
| *Var.* 28° 15′ *W.* | | | | | | |
| The Bass Rock | 56 | 4 | 53 | 2 | 37 | 47 |
| Dunbar | 56 | 0 | 30 | 2 | 30 | 20 |
| St. Abb's Head | 55 | 55 | 30 | 2 | 8 | 0 |
| Eyemouth | 55 | 52 | 42 | 2 | 4 | 45 |
| Berwick | 55 | 46 | 21 | 1 | 59 | 41 |
| Holy Island Castle | 55 | 40 | 20 | 1 | 46 | 38 |
| Bamburgh Castle | 55 | 36 | 42 | 1 | 42 | 8 |
| Staples Light | 55 | 38 | 9 | 1 | 37 | 5 |
| Fern I. Light | 55 | 37 | 11 | 1 | 38 | 51 |
| Sunderland Point | 55 | 34 | 45 | 1 | 37 | 56 |
| Coquet Island, — Tower | 55 | 20 | 11 | 1 | 31 | 47 |
| Tynemouth Light | 55 | 1 | 21 | 1 | 24 | 31 |
| Sunderland Light | 54 | 55 | 12 | 1 | 21 | 16 |
| Hartlepool Church | 54 | 41 | 49 | 1 | 10 | 31 |
| River Tees, entrance | 54 | 38 | 0 | 1 | 5 | 0 |
| Stockton | 54 | 33 | 0 | 1 | 14 | 0 |
| Whitby | 54 | 28 | 30 | 0 | 35 | 20 |
| Scarborough | 54 | 18 | 0 | 0 | 23 | 0 |
| Filey Brig | 54 | 14 | 0 | 0 | 14 | 0 |
| Flambro' Head Light | 54 | 7 | 50 | 0 | 2 | 20 |
| *Var.* 25° *W.* 1828. | | | | | | |

East Coast of England.

| (6) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Spurn Lights | 53 | 34 | 44 | 0 | 7 | 9 |
| Lynn Regis | 52 | 45 | 23 | 0 | 25 | 4 |
| Hunstanton Light | 52 | 57 | 8 | 0 | 29 | 41 |
| Outer Dowsing, mid. | 53 | 30 | 0 | 0 | 55 | 0 |
| Haddocks Bank, mid. | 53 | 32 | 0 | 1 | 40 | 0 |
| Dudgeon Light | 53 | 19 | 0 | 0 | 55 | 0 |
| Inner Dowsing, N.end | 53 | 20 | 0 | 0 | 34 | 0 |
| Cromer Inner Bk. mid. | 53 | 9 | 0 | 1 | 24 | 0 |
| Lemon, North Elbow | 53 | 8 | 0 | 1 | 54 | 0 |
| SherringhamShsE.end | 53 | 2 | 0 | 1 | 15 | 30 |
| Smith's Knowl, mid. | 52 | 53 | 0 | 2 | 16 | 0 |
| Cromer Light | 52 | 55 | 20 | 1 | 19 | 30 |
| Hasborough Lights | 52 | 49 | 0 | 1 | 33 | 0 |
| Winterton | 52 | 44 | 15 | 1 | 42 | 0 |
| Yarmouth Church | 52 | 36 | 40 | 1 | 44 | 22 |
| Leostoff High Light | 52 | 29 | 10 | 1 | 45 | 14 |
| Southwold Church | 52 | 20 | 0 | 1 | 40 | 0 |
| Aldbro' Knaps | 52 | 8 | 0 | 1 | 42 | 0 |
| Orfordness Light | 52 | 5 | 0 | 1 | 31 | 14 |
| Landguard Fort | 51 | 56 | 18 | 1 | 19 | 4 |
| Harwich Church | 51 | 56 | 43 | 1 | 17 | 8 |
| Walton To on the Naze | 51 | 51 | 51 | 1 | 17 | 7 |
| Galloper Light Vessel | 51 | 44 | 30 | 1 | 53 | 30 |
| Inner Garbard Buoy | 51 | 56 | 0 | 1 | 56 | 0 |
| Outer Garbard Buoy | 51 | 58 | 40 | 2 | 3 | 45 |

## II. COAST OF IRELAND.

West Coast of Ireland.

| | | | | West | | |
|---|---|---|---|---|---|---|
| Cape Clear Light | 51 | 24 | 55 | 9 | 29 | 0 |
| Fastnet Rock | 51 | 22 | 0 | 9 | 37 | 0 |
| Crookhaven entr. | 51 | 27 | 0 | 9 | 43 | 0 |
| Mizen Head | 51 | 26 | 0 | 9 | 51 | 0 |
| Bantry Bay | | | | | | |
| — Sheep's Head | 51 | 31 | 0 | 9 | 52 | 0 |
| Crow Point | 51 | 34 | 0 | 10 | 12 | 0 |
| Dursey I. W. end | 51 | 34 | 0 | 10 | 15 | 0 |
| Kenmare Harbour | | | | | | |
| — Cod's Head | 51 | 40 | 0 | 10 | 7 | 0 |
| — Lamb's Head | 51 | 44 | 0 | 10 | 8 | 0 |
| *Var.* 2¾ *Points W.* | | | | | | |
| Hog Islands | 51 | 44 | 0 | 10 | 17 | 0 |
| Bolus Head | 51 | 46 | 0 | 10 | 24 | 0 |
| Skellig Rks. and Lts. | 51 | 46 | 0 | 10 | 34 | 0 |
| Dingle Bay | | | | | | |
| — Bray Head | 51 | 52 | 0 | 10 | 29 | 0 |
| — Valentia Harb. ent. | 51 | 55 | 0 | 10 | 20 | 0 |
| — Dunmore Head | 52 | 6 | 0 | 10 | 32 | 0 |
| Foze Rock | 52 | 1 | 15 | 10 | 41 | 50 |
| Ferriter's Island | 52 | 2 | 30 | 10 | 38 | 0 |
| Tiraght Rocks | 52 | 4 | 0 | 10 | 40 | 0 |
| Gt. Blaskett, W. end | 52 | 8 | 30 | 10 | 36 | 0 |
| Ennis Tuskar | 52 | 8 | 0 | 10 | 36 | 0 |
| Dunorling Head | 52 | 11 | 0 | 10 | 28 | 0 |
| Brandon Head | 52 | 17 | 0 | 10 | 10 | 0 |
| Shannon Mouth, | | | | | | |
| — Kerry Head | 52 | 27 | 0 | 9 | 53 | 0 |
| — Loop Head | 52 | 34 | 0 | 9 | 52 | 28 |
| Limerick | 52 | 39 | 0 | 8 | 33 | 0 |
| Clare | 52 | 47 | 0 | 8 | 53 | 0 |
| Hags Head | 52 | 59 | 0 | 9 | 18 | 0 |

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## LATITUDES AND LONGITUDES.

| (7) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *W. Coast of Ireland.* Galway Bay, | | | | | | |
| — Black Head | 53 | 10 | 0 | 9 | 6 | 0 |
| — Galway | 53 | 17 | 0 | 8 | 51 | 0 |
| N. Arran I. Light | 53 | 8 | 0 | 9 | 35 | 0 |
| Skird Rocks | 53 | 16 | 0 | 9 | 55 | 0 |
| Sline Head | 53 | 27 | 0 | 10 | 7 | 0 |
| Shark Island | 53 | 38 | 0 | 10 | 10 | 0 |
| Ennis Turk I. | 53 | 45 | 0 | 10 | 0 | 0 |
| Clare I. Light | 53 | 51 | 0 | 9 | 32 | 0 |
| Achill Head | 54 | 0 | 0 | 10 | 8 | 0 |
| Black Rock | 54 | 7 | 0 | 10 | 13 | 0 |
| Broad Haven, | | | | | | |
| — Urris Head | 54 | 22 | 0 | 9 | 58 | 0 |
| Three Tuns Rocks | 54 | 25 | 0 | 9 | 44 | 0 |
| Down Patrick Head | 54 | 23 | 0 | 9 | 20 | 0 |
| Killala | 54 | 16 | 0 | 9 | 10 | 0 |
| Sligo | 54 | 20 | 0 | 8 | 28 | 0 |
| Ennis Murry | 54 | 31 | 0 | 8 | 40 | 0 |
| Donegal | 54 | 43 | 0 | 8 | 5 | 0 |
| St. John's Cape | 54 | 38 | 0 | 8 | 26 | 0 |
| *North Coast of Ireland.* Tillen Head | 54 | 43 | 0 | 8 | 47 | 0 |
| Daurus Head | 54 | 53 | 0 | 8 | 34 | 0 |
| Arranmore I. Light | 55 | 3 | 0 | 8 | 32 | 0 |
| Bloody Foreland | 55 | 11 | 0 | 8 | 15 | 0 |
| Tory Island, N.W. Pt. | 55 | 18 | 0 | 8 | 12 | 0 |
| Horn Head | 55 | 15 | 0 | 7 | 58 | 0 |
| Melmore Head | 55 | 17 | 0 | 7 | 48 | 0 |
| Loch Swilly, | | | | | | |
| — Pt. Fannett Light | 55 | 18 | 0 | 7 | 38 | 0 |
| — Dunaff Head | 55 | 19 | 0 | 7 | 32 | 0 |
| Mullin Head | 55 | 23 | 0 | 7 | 25 | 0 |
| Ennistrahul Light | 55 | 26 | 30 | 7 | 14 | 0 |
| *Var. 30° W.* | | | | | | |
| Inishone Head | 55 | 15 | 0 | 6 | 54 | 0 |
| Londonderry | 54 | 59 | 28 | 7 | 14 | 45 |
| Giants Causeway | 55 | 16 | 0 | 6 | 24 | 0 |
| Rachlin I., W. end | 55 | 19 | 0 | 6 | 12 | 0 |
| Fair Head | 55 | 15 | 0 | 6 | 3 | 0 |
| Tor Head | 55 | 13 | 0 | 5 | 58 | 0 |
| Maiden Rocks, N. end | 54 | 59 | 0 | 5 | 36 | 0 |
| Black Head | 54 | 47 | 0 | 5 | 36 | 0 |
| Carrickfergus | 54 | 43 | 0 | 5 | 45 | 30 |
| Belfast | 54 | 35 | 30 | 5 | 55 | 0 |
| Mew I. and Light | 54 | 42 | 0 | 5 | 25 | 0 |
| South Rock Light | 54 | 22 | 0 | 5 | 26 | 0 |
| *East Coast of Ireland.* Ardglass Light | 54 | 15 | 0 | 5 | 39 | 0 |
| Dundrum | 54 | 14 | 0 | 5 | 52 | 0 |
| Cranfield Pt. & Light | 54 | 0 | 0 | 6 | 4 | 0 |
| Dundalk | 53 | 59 | 30 | 6 | 20 | 0 |
| Clougher Head | 53 | 50 | 0 | 6 | 13 | 0 |
| Drogheda Bar | 53 | 44 | 0 | 6 | 15 | 0 |
| St. Patrick's Island | 53 | 36 | 0 | 6 | 5 | 0 |
| Lambay Island | 53 | 30 | 12 | 6 | 0 | 12 |
| Howth Head Light | 53 | 22 | 30 | 6 | 3 | 0 |
| DUBLIN Light | 53 | 21 | 13 | 6 | 5 | 13 |
| — Observatory | 53 | 23 | 13 | 6 | 20 | 30 |
| *Var. 26° 30′ W.* | | | | | | |
| Wicklow Lights | 52 | 59 | 0 | 5 | 58 | 0 |
| Arklow | 52 | 50 | 0 | 6 | 5 | 30 |
| Glascarrick Point | 52 | 36 | 0 | 6 | 8 | 0 |

| (8) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Wexford Harb. ent. | 52 | 22 | 0 | 6 | 18 | 0 |
| Carnsore Point | 52 | 11 | 30 | 6 | 18 | 0 |
| Tuskar Rock & Light | 52 | 13 | 0 | 6 | 7 | 0 |
| Saltees Rocks | 52 | 6 | 0 | 6 | 34 | 0 |
| Hook Light | 52 | 5 | 0 | 6 | 54 | 0 |
| *South Coast of Ireland.* Waterford | 52 | 12 | 0 | 7 | 6 | 0 |
| Tramore | 52 | 7 | 0 | 7 | 7 | 0 |
| Dungarvon | 52 | 3 | 0 | 7 | 34 | 0 |
| Helwick Head | 51 | 59 | 30 | 7 | 27 | 0 |
| Youghall | 51 | 53 | 0 | 7 | 51 | 0 |
| Roche's Pt. & Light | 51 | 46 | 0 | 8 | 11 | 0 |
| Cork | 51 | 53 | 54 | 8 | 28 | 0 |
| *Var. 28° W.* | | | | | | |
| Kinsale Light | 51 | 37 | 0 | 8 | 27 | 0 |
| Seven Heads | 51 | 35 | 0 | 8 | 39 | 0 |
| Gally Head | 51 | 33 | 0 | 8 | 50 | 0 |
| Ross | 51 | 35 | 0 | 8 | 56 | 0 |
| Stags off Toe Head | 51 | 26 | 0 | 9 | 10 | 0 |
| Baltimore | 51 | 28 | 0 | 9 | 20 | 0 |

## III. Coast of LAPLAND & NORWAY, From Nova Zembla to the Naze.

| | | | | East. | | |
|---|---|---|---|---|---|---|
| Nova Zembla, N. Pt. | 76 | 34 | 0 | 62 | 45 | 0 |
| Weigates Strait | 70 | 50 | 0 | 57 | 45 | 0 |
| Cape Candinose | 68 | 38 | 30 | 44 | 36 | 0 |
| Cape Kapuchin | 67 | 11 | 0 | 44 | 53 | 0 |
| Morshovets I., S. Pt. | 66 | 40 | 0 | 43 | 27 | 0 |
| C. Voronou or Good Fortune | 66 | 31 | 0 | 42 | 53 | 0 |
| C. Katness | 65 | 26 | 0 | 39 | 54 | 0 |
| *White Sea.* Archangel, outer Rd. | 64 | 57 | 0 | 40 | 15 | 0 |
| — City | 64 | 31 | 40 | 40 | 43 | 15 |
| *Var. 2° W.* | | | | | | |
| Cape Donega | 65 | 8 | 0 | 36 | 47 | 0 |
| Pushlackta Bay, entr. | 64 | 51 | 0 | 36 | 20 | 0 |
| Onega | 63 | 53 | 36 | 37 | 58 | 30 |
| Anger I. E. end | 65 | 11 | 0 | 36 | 14 | 0 |
| Kandalax | 67 | 11 | 0 | 32 | 22 | 0 |
| Cross Island | 66 | 27 | 30 | 40 | 28 | 0 |
| Ponoi | 67 | 4 | 30 | 41 | 9 | 15 |
| Cape Orlogeness | 67 | 14 | 0 | 41 | 22 | 0 |
| Cape Sweetnose | 68 | 10 | 0 | 40 | 3 | 0 |
| *Var. 1° W.* | | | | | | |
| *Coast of Norway and Lapland.* Nagel Island, N. end | 68 | 32 | 0 | 38 | 2 | 0 |
| Kilduin Island | 69 | 10 | 0 | 33 | 50 | 0 |
| Kola | 68 | 52 | 28 | 33 | 0 | 45 |
| Wardhuys Island | 70 | 22 | 36 | 31 | 6 | 45 |
| North Cape | 71 | 10 | 15 | 26 | 0 | 45 |
| Hammerfest, | | | | | | |
| —Fugleness Point | 70 | 39 | 51 | 23 | 43 | 15 |
| *Var. 11° 26′ W.* | | | | | | |
| Altengaard | 69 | 55 | 0 | 23 | 4 | 15 |
| Sand-oe | 68 | 56 | 15 | 16 | 49 | 45 |
| Loffoden Isles, | | | | | | |
| — Wœroe or Werro I. | 67 | 42 | 0 | 11 | 41 | 0 |
| — Rost Island | 67 | 37 | 0 | 10 | 59 | 0 |

## LATITUDES AND LONGITUDES.

| (9) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Coasts of Norway and Lapland.* | | | | | | |
| Vigten Isles, | | | | | | |
| — Soroe | 64 | 44 | 30 | 10 | 50 | 0 |
| Halten Isles, middle | 64 | 11 | 0 | 9 | 22 | 0 |
| Froyen, S. W. end | 63 | 40 | 30 | 8 | 16 | 0 |
| Drontheim | 63 | 25 | 50 | 10 | 23 | 25 |
| *Var. 22° 30′ W.* | | | | | | |
| Griboerne, middle | 63 | 14 | 0 | 7 | 34 | 0 |
| Christiansund | 63 | 7 | 0 | 7 | 42 | 0 |
| Lingvan Fiord, entr. | 62 | 57 | 0 | 6 | 47 | 0 |
| Haaevaer Sund, entr. | 62 | 52 | 0 | 6 | 26 | 0 |
| Nogva Fiord, entr. | 62 | 43 | 0 | 6 | 10 | 0 |
| Molde | 62 | 44 | 0 | 7 | 8 | 30 |
| Rondoe Lighthouse | 62 | 24 | 30 | 5 | 35 | 30 |
| Stadt Land, N.W. Pt. | 62 | 11 | 30 | 5 | 7 | 30 |
| Froe Soen, entrance | 61 | 41 | 30 | 4 | 49 | 0 |
| Tempa Bank, mid. | 61 | 27 | 0 | 4 | 31 | 0 |
| Bueland, N. W. end | 61 | 17 | 30 | 4 | 37 | 0 |
| Aspo I., N. end | 61 | 13 | 0 | 4 | 46 | 0 |
| Udver Isles | 61 | 2 | 0 | 4 | 32 | 0 |
| Blomoe | 60 | 32 | 0 | 4 | 54 | 30 |
| Bergen Castle | 60 | 24 | 0 | 5 | 20 | 0 |
| *Var. 24° 45′ W.* | | | | | | |
| Kors Fiord, entrance | 60 | 8 | 30 | 5 | 1 | 0 |
| Fugloe | 60 | 1 | 0 | 5 | 2 | 0 |
| Selboe Fiord, entr. | 59 | 57 | 0 | 5 | 2 | 0 |
| Bommel-oe, S. end | 59 | 35 | 0 | 5 | 13 | 0 |
| Skudesnaes Light | 59 | 8 | 40 | 5 | 19 | 0 |
| Hviddings-oe Light | 59 | 3 | 50 | 5 | 24 | 30 |
| *Norway.* Stavanger | 58 | 58 | 30 | 5 | 45 | 0 |
| *Var. 2 points W.* | | | | | | |
| Jedderen Reef | 58 | 45 | 40 | 5 | 29 | 0 |
| Lister Land, W. Pt. | 58 | 5 | 40 | 6 | 36 | 0 |
| Markoe Light | 57 | 59 | 0 | 6 | 59 | 0 |
| Lindernœs or Naze Lt. | 57 | 57 | 50 | 7 | 3 | 15 |
| *Var. 22° 30′ W.* | | | | | | |

### IV. The CATTEGAT and SOUND.

| | | | | | | |
|---|---|---|---|---|---|---|
| Skagen or Scaw Light | 57 | 43 | 44 | 10 | 37 | 30 |
| Fladstrand | 57 | 27 | 3 | 10 | 33 | 15 |
| Sæbye | 57 | 20 | 2 | 10 | 33 | 9 |
| *Jutland.* Aalborg | 57 | 2 | 32 | 9 | 56 | 41 |
| Grenaae | 56 | 24 | 57 | 10 | 53 | 59 |
| Aarhuus | 56 | 9 | 35 | 10 | 14 | 5 |
| Apenrade | 55 | 2 | 57 | 9 | 26 | 38 |
| Flensborg | 54 | 47 | 18 | 9 | 27 | 40 |
| Sleswick | 54 | 31 | 27 | 9 | 33 | 57 |
| Lindernæs or Naze Lt. | 57 | 57 | 30 | 7 | 3 | 15 |
| Mandal | 58 | 0 | 40 | 7 | 28 | 30 |
| Fleckeroe Haven | 58 | 5 | 0 | 8 | 2 | 0 |
| Christiansand | 58 | 8 | 4 | 8 | 3 | 0 |
| Arendal | 58 | 27 | 0 | 8 | 51 | 20 |
| *Norway.* Oster Risoer | 58 | 42 | 30 | 9 | 19 | 30 |
| Krageroe | 58 | 51 | 30 | 9 | 30 | 30 |
| Friderichsværn | 58 | 59 | 0 | 10 | 7 | 0 |
| Færder Light | 59 | 3 | 30 | 10 | 36 | 20 |
| Fulehuk Light | 59 | 10 | 20 | 10 | 40 | 0 |
| Agero Fort | 59 | 2 | 35 | 10 | 57 | 0 |
| Christiania | 59 | 55 | 20 | 10 | 48 | 30 |
| Friderichstad | 59 | 12 | 0 | 11 | 1 | 0 |

| (10) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Sweden.* Stromstad | 58 | 56 | 0 | 11 | 15 | 0 |
| Salœ Light | 58 | 21 | 0 | 11 | 15 | 30 |
| Paternosters, S.W. end | 57 | 53 | 30 | 11 | 28 | 0 |
| Marstrand Light | 57 | 53 | 51 | 11 | 36 | 0 |
| Gothenburg | 57 | 42 | 4 | 11 | 57 | 45 |
| Wingoe Beacon | 57 | 38 | 13 | 11 | 37 | 40 |
| Vanguard Shoal | 57 | 32 | 30 | 11 | 39 | 0 |
| Tislerne | 57 | 31 | 0 | 11 | 44 | 0 |
| Niddingen Lights | 57 | 18 | 30 | 11 | 55 | 0 |
| Warberg | 57 | 6 | 18 | 12 | 16 | 0 |
| Falkenberg | 56 | 54 | 30 | 12 | 30 | 0 |
| Halmstad | 56 | 39 | 45 | 12 | 51 | 45 |
| Laholm | 56 | 32 | 38 | 13 | 0 | 45 |
| Hollands Wadero, | | | | | | |
| —South end | 56 | 26 | 0 | 12 | 35 | 0 |
| Engelholm | 56 | 14 | 20 | 12 | 54 | 0 |
| Koll Light | 56 | 18 | 3 | 12 | 27 | 32 |
| Helsingborg | 56 | 2 | 55 | 12 | 43 | 0 |
| Landskrona | 55 | 52 | 27 | 12 | 50 | 46 |
| Lunden, Obs. | 55 | 42 | 26 | 13 | 12 | 27 |
| Malmo | 55 | 36 | 37 | 13 | 1 | 19 |
| Falsterbo Light | 55 | 23 | 8 | 12 | 49 | 17 |
| Steffen's Head Light | 55 | 17 | 30 | 12 | 27 | 0 |
| Kioge | 55 | 27 | 40 | 12 | 11 | 0 |
| COPENHAGEN obs. | 55 | 41 | 4 | 12 | 35 | 6 |
| *Var. 19° W.* | | | | | | |
| *Zeeland.* Elsineur | 56 | 2 | 17 | 12 | 37 | 0 |
| Cronborg Castle & Lt. | 56 | 2 | 22 | 12 | 37 | 40 |
| Nakke Head Lights | 56 | 7 | 0 | 12 | 21 | 0 |
| Nykiobing | 55 | 55 | 0 | 11 | 40 | 30 |
| Callundborg | 55 | 40 | 54 | 11 | 6 | 18 |
| Corsoer | 55 | 19 | 30 | 11 | 9 | 30 |
| Wordingborg | 55 | 0 | 30 | 11 | 56 | 0 |
| *Is. in Cattegat, Sound, and Belt.* Huen I. Uranienberg | 55 | 54 | 38 | 12 | 42 | 59 |
| Amag Island, Drago | 55 | 36 | 0 | 12 | 41 | 0 |
| Hassen Island | 56 | 11 | 46 | 11 | 42 | 30 |
| Sproe Island Light | 55 | 20 | 0 | 10 | 59 | 0 |
| Moen I. Speil Cliff | 54 | 58 | 0 | 12 | 33 | 44 |
| Falster I. Geedesbye or Trindelen Light | 54 | 34 | 16 | 11 | 59 | 0 |
| Anholt Light | 56 | 44 | 20 | 11 | 39 | 50 |
| Great Middle Ground | 56 | 34 | 0 | 12 | 5 | 0 |
| Little Middle Ground | 56 | 57 | 20 | 11 | 59 | 0 |
| Lessoe, East end | 57 | 19 | 0 | 11 | 11 | 30 |
| — West end | 57 | 16 | 0 | 10 | 53 | 0 |
| Trindelen Rock | 57 | 25 | 30 | 11 | 15 | 0 |

### V. The BALTIC.

| | | | | | | |
|---|---|---|---|---|---|---|
| Fyen, Odense | 55 | 23 | 30 | 10 | 24 | 0 |
| — Fyen Head | 55 | 37 | 0 | 10 | 38 | 0 |
| — Knudes Head | 55 | 17 | 40 | 10 | 52 | 0 |
| Langeland, N. end | 55 | 20 | 0 | 10 | 57 | 0 |
| — S. end, Light | 54 | 44 | 0 | 10 | 44 | 0 |
| — Rudkiobing | 54 | 56 | 30 | 10 | 44 | 0 |
| *Danish Isles.* Æroe, Kiobing | 54 | 53 | 0 | 10 | 25 | 0 |
| Alsen, Sonderborg | 54 | 54 | 59 | 9 | 48 | 20 |
| Laaland, Naskoi | 54 | 50 | 0 | 11 | 10 | 0 |
| Falster, Nyekiobing | 54 | 46 | 0 | 11 | 53 | 30 |

## LATITUDES AND LONGITUDES.

| | (11) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Sweden. | Moen, Steege | 54 | 59 | 30 | 12 | 18 | 0 |
| | Femeren, Borg | 54 | 28 | 0 | 11 | 13 | 0 |
| | Trelleborg | 55 | 23 | 0 | 13 | 10 | 0 |
| | Ystad | 55 | 25 | 52 | 13 | 50 | 1 |
| | Cimbritshamn Church | 55 | 33 | 40 | 14 | 19 | 19 |
| | Ahus | 55 | 55 | 30 | 14 | 16 | 20 |
| | Hano | 56 | 1 | 2 | 14 | 48 | 25 |
| | Carlshamn | 56 | 10 | 30 | 14 | 50 | 0 |
| | Terno, S. end | 56 | 6 | 51 | 14 | 56 | 25 |
| | Carlskrona Gt. Ch. | 56 | 10 | 9 | 15 | 33 | 26 |
| | Utklipporne Rocks | 55 | 56 | 35 | 15 | 39 | 51 |
| | Torum Point | 56 | 4 | 0 | 15 | 48 | 0 |
| | Calmar Church | 56 | 40 | 29 | 16 | 21 | 44 |
| | Westerwyk | 57 | 45 | 0 | 16 | 37 | 0 |
| | Sparo Beacon | 57 | 42 | 16 | 16 | 42 | 55 |
| | Haradskar Beacon | 58 | 8 | 4 | 16 | 58 | 25 |
| | Arko, Stangskar | 58 | 28 | 10 | 16 | 59 | 55 |
| | Hafringe Beacon | 58 | 36 | 0 | 17 | 18 | 2 |
| | Landsort Lighthouse | 58 | 44 | 28 | 17 | 51 | 45 |
| | Dalaro, entrance to | 59 | 6 | 55 | 18 | 24 | 3 |
| | STOCKHOLM obs. | 59 | 20 | 31 | 18 | 3 | 45 |
| | Korso Light | 59 | 17 | 20 | 18 | 57 | 53 |
| | Gronskars Light | 59 | 17 | 0 | 19 | 12 | 30 |
| | Svenskahogar | 59 | 27 | 0 | 19 | 30 | 0 |
| | Soderarm Beacon | 59 | 45 | 22 | 19 | 24 | 5 |
| Germany. | Keil | 54 | 19 | 43 | 10 | 8 | 18 |
| | LUBEC | 53 | 51 | 18 | 10 | 49 | 52 |
| | Wismar | 53 | 51 | 30 | 11 | 39 | 0 |
| | Rostock | 54 | 3 | 0 | 12 | 11 | 0 |
| | Dars Head | 54 | 30 | 0 | 12 | 30 | 0 |
| | Stralsund | 54 | 19 | 28 | 13 | 7 | 5 |
| | Wollin | 53 | 51 | 0 | 14 | 37 | 0 |
| | STETTIN | 53 | 26 | 0 | 14 | 33 | 0 |
| | Camin | 53 | 59 | 0 | 14 | 45 | 0 |
| | Colberg, Bar | 54 | 10 | 50 | 15 | 37 | 44 |
| | Rugenvalde, entr. to | 54 | 25 | 0 | 16 | 25 | 0 |
| Prussia. | Reserhooft Light | 54 | 50 | 4 | 18 | 18 | 30 |
| | Heel Light | 54 | 35 | 10 | 18 | 48 | 22 |
| | DANTZIG | 54 | 20 | 48 | 18 | 38 | 5 |
| | Pillau Light | 54 | 38 | 12 | 19 | 53 | 59 |
| | Konigsberg | 54 | 42 | 12 | 20 | 29 | 15 |
| | Brusterort Lights | 54 | 57 | 36 | 19 | 59 | 1 |
| | Memel | 55 | 41 | 42 | 21 | 7 | 59 |
| | Libau | 56 | 31 | 10 | 20 | 56 | 25 |
| | Windau | 57 | 24 | 30 | 21 | 31 | 0 |
| | Lyserort | 57 | 34 | 0 | 21 | 40 | 0 |
| | Domesness Lights | 57 | 46 | 12 | 22 | 31 | 59 |
| Russia. | Runo I., Light | 57 | 48 | 1 | 23 | 11 | 0 |
| | RIGA Church | 56 | 56 | 5 | 24 | 0 | 4 |
| | Dunamnude Lights | 57 | 1 | 35 | 23 | 55 | 1 |
| | Pernau | 58 | 21 | 0 | 24 | 25 | 0 |
| | Dago, Dagerort Hd. | 58 | 56 | 5 | 22 | 0 | 37 |
| | — Dagerort Light | 58 | 55 | 9 | 22 | 10 | 12 |
| | Filsand Light | 58 | 23 | 0 | 21 | 46 | 0 |
| | Oesel, Palmerort | 58 | 39 | 0 | 22 | 30 | 0 |
| | — Hundsort | 58 | 31 | 0 | 21 | 53 | 0 |
| | — Svartverort Light | 57 | 55 | 0 | 22 | 1 | 8 |

| | (12) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Islands in the Baltic. | — Arensberg | 58 | 15 | 9 | 22 | 27 | 45 |
| | Gottska Sando, — Nybygget | 58 | 20 | 57 | 19 | 13 | 17 |
| | Faro, Holm Head | 57 | 57 | 30 | 19 | 23 | 10 |
| | Gottland, — Halshuk | 57 | 55 | 27 | 18 | 43 | 54 |
| | — Wisby | 57 | 38 | 50 | 18 | 16 | 21 |
| | — Little Carlso | 57 | 19 | 39 | 18 | 4 | 36 |
| | — Great Carlso | 57 | 18 | 0 | 17 | 58 | 0 |
| | — Hoborg | 56 | 55 | 9 | 18 | 7 | 32 |
| | — Farosund | 57 | 51 | 48 | 19 | 4 | 20 |
| | Ostergarnsholm Light | 57 | 26 | 10 | 19 | 0 | 0 |
| | Oland, North Head | 57 | 22 | 30 | 17 | 6 | 30 |
| | — South Head Light | 56 | 12 | 3 | 16 | 23 | 9 |
| | Eartholms, Christian Oe Light | 55 | 19 | 9 | 15 | 11 | 12 |
| | Bornholm, Hammeren Light | 55 | 17 | 39 | 14 | 46 | 13 |
| | — Ronne Church | 55 | 6 | 16 | 14 | 41 | 53 |
| | — Due Odde | 54 | 59 | 6 | 15 | 5 | 27 |
| | — Svaneke Church | 55 | 7 | 54 | 15 | 8 | 40 |
| | Rugen, Arcona | 54 | 41 | 4 | 13 | 27 | 53 |
| | — Bergen Church | 54 | 25 | 32 | 13 | 27 | 41 |
| | — S. E. end | 54 | 16 | 30 | 13 | 45 | 0 |

## VI. The Gulfs of FINLAND and BOTHNIA.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| S. Coast of the Gulf of Finland. | Dago I., Dagerort Hd. | 58 | 56 | 5 | 22 | 0 | 37 |
| | — Dagerort Light | 58 | 55 | 9 | 22 | 10 | 12 |
| | Odensholm Light | 59 | 17 | 56 | 23 | 20 | 58 |
| | Packerort Light | 59 | 24 | 20 | 24 | 2 | 0 |
| | Surop Head | 59 | 28 | 30 | 24 | 20 | 0 |
| | Nargen I., N. Point | 59 | 36 | 1 | 24 | 28 | 23 |
| | REVEL, St. Olai Ch. | 59 | 26 | 11 | 24 | 42 | 8 |
| | Kokskar Light | 59 | 41 | 30 | 24 | 57 | 0 |
| | Ekholm Light | 59 | 41 | 20 | 25 | 43 | 30 |
| | Stoneskar Beacon | 59 | 49 | 30 | 26 | 18 | 0 |
| | Rothskar Light | 59 | 59 | 0 | 26 | 37 | 0 |
| | Little Tyters, N.W. end | 59 | 50 | 0 | 26 | 48 | 0 |
| | Great Tyters, S. end | 59 | 51 | 0 | 27 | 7 | 0 |
| | Narva Lighthouse | 59 | 28 | 0 | 28 | 1 | 0 |
| | Lavenskar, Kupka | 60 | 1 | 0 | 27 | 44 | 0 |
| | Seskar Lighthouse | 60 | 1 | 30 | 28 | 17 | 0 |
| | Dolgoinoss | 59 | 51 | 0 | 28 | 54 | 0 |
| | Tollbaken Light | 60 | 3 | 38 | 29 | 32 | 33 |
| | CRONSTADT | 59 | 59 | 26 | 29 | 47 | 30 |
| | PETERSBURG, Obs | 59 | 56 | 13 | 30 | 17 | 33 |
| N. Coast of the G. of Finland. | Wiburg | 60 | 42 | 40 | 28 | 46 | 5 |
| | Nervo Tower | 60 | 14 | 0 | 27 | 53 | 0 |
| | Sommar Lighthouse | 60 | 12 | 0 | 27 | 34 | 0 |
| | Aspo Beacon | 60 | 17 | 32 | 27 | 8 | 2 |
| | Hogland North Light | 60 | 6 | 34 | 26 | 53 | 21 |
| | Lovisa Church | 60 | 27 | 38 | 26 | 10 | 40 |
| | Orrenground Beacon | 60 | 16 | 35 | 26 | 23 | 1 |
| | Great Pellinge, S. side | 60 | 12 | 25 | 25 | 48 | 43 |
| | Sandkallan Rock | 60 | 2 | 35 | 25 | 44 | 45 |
| | Helsingfors | 60 | 10 | 50 | 24 | 58 | 0 |
| | Ronskar Lighthouse | 59 | 55 | 28 | 24 | 22 | 8 |
| | Great Jussari | 59 | 49 | 43 | 23 | 33 | 12 |

## LATITUDES AND LONGITUDES.

| (13) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Gulf of Bothnia.* Hango Beacon | 59 | 46 | 20 | 22 | 57 | 45 |
| Abo Great Church | 60 | 26 | 58 | 22 | 17 | 0 |
| Uto Lighthouse | 59 | 46 | 40 | 21 | 19 | 45 |
| Enskar Light | 60 | 14 | 0 | 19 | 14 | 0 |
| Svartklubben Light | 60 | 11 | 0 | 18 | 44 | 0 |
| Oskaret Light | 60 | 32 | 0 | 18 | 15 | 0 |
| Gefle | 60 | 39 | 45 | 17 | 0 | 0 |
| Soderhamn | 61 | 17 | 0 | 16 | 56 | 0 |
| Bremon, N. end | 62 | 13 | 0 | 17 | 36 | 0 |
| Hernosand | 62 | 38 | 0 | 17 | 47 | 0 |
| Gadden Light | 63 | 36 | 0 | 20 | 40 | 0 |
| Tornea | 65 | 50 | 50 | 24 | 9 | 0 |
| Uleaborg | 65 | 3 | 0 | 25 | 30 | 0 |
| Brahestad | 64 | 41 | 0 | 24 | 31 | 0 |
| Ny Carleby | 63 | 33 | 0 | 22 | 32 | 0 |
| Wasa | 63 | 6 | 0 | 21 | 36 | 0 |
| Christinestad | 62 | 16 | 0 | 21 | 15 | 0 |
| Nystad | 60 | 49 | 0 | 21 | 23 | 0 |

## VII. Coasts of DENMARK, GERMANY, HOLLAND, and NETHERLANDS.

From the Scaw to Calais.

| | | | | | | |
|---|---|---|---|---|---|---|
| *Denmark.* Scaw Light | 57 | 43 | 44 | 10 | 37 | 30 |
| Robsnout | 57 | 25 | 0 | 9 | 45 | 0 |
| Oester Head | 57 | 10 | 0 | 8 | 58 | 0 |
| Holmen | 57 | 8 | 0 | 8 | 37 | 30 |
| Point Horn | 55 | 34 | 15 | 8 | 5 | 0 |
| Helegoland Light | 54 | 11 | 34 | 7 | 53 | 13 |
| Elbe R., Red Buoy | 53 | 59 | 10 | 8 | 20 | 15 |
| *Var.* 20° *W.* | | | | | | |
| *Germany.* Nework | 53 | 55 | 19 | 8 | 31 | 24 |
| Cuxhaven | 53 | 52 | 21 | 8 | 43 | 10 |
| Glukstadt | 53 | 47 | 42 | 9 | 27 | 2 |
| Stade | 53 | 36 | 32 | 9 | 28 | 34 |
| HAMBURGH | 53 | 32 | 51 | 9 | 58 | 22 |
| Bremerlehe | 53 | 33 | 28 | 8 | 34 | 30 |
| BREMEN | 53 | 4 | 38 | 8 | 48 | 0 |
| Wrangeroog Light | 53 | 48 | 26 | 7 | 52 | 35 |
| Borcum Light | 53 | 36 | 0 | 6 | 38 | 0 |
| Emden | 53 | 22 | 3 | 7 | 11 | 1 |
| Gottingen Obs. | 51 | 31 | 50 | 9 | 56 | 30 |
| Ter Schelling, W. end | 53 | 22 | 30 | 5 | 12 | 0 |
| Harlingen | 53 | 10 | 32 | 5 | 24 | 47 |
| Entr. to Texel, | | | | | | |
| — Kyk Down Fort | 52 | 57 | 3 | 4 | 43 | 10 |
| *Holland.* Alkmaar | 52 | 37 | 11 | 4 | 45 | 0 |
| AMSTERDAM | 52 | 22 | 17 | 4 | 53 | 15 |
| Haarlem | 52 | 22 | 56 | 4 | 38 | 19 |
| Leyden | 52 | 9 | 30 | 4 | 29 | 13 |
| The Hague | 52 | 4 | 50 | 4 | 18 | 47 |
| Holland's Hook | 51 | 57 | 0 | 4 | 5 | 0 |
| ROTTERDAM | 51 | 54 | 4 | 4 | 27 | 50 |
| *Var.* 24° *W.* | | | | | | |
| Briel | 51 | 54 | 30 | 4 | 9 | 25 |
| Hellevoetsluys | 51 | 49 | 42 | 4 | 7 | 35 |
| Goeree | 51 | 49 | 15 | 3 | 59 | 36 |

| (14) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Walcheren, | | | | | | |
| — West Cappel Light | 51 | 31 | 45 | 3 | 26 | 55 |
| Middleburg | 51 | 30 | 6 | 3 | 37 | 30 |
| FLUSHING | 51 | 26 | 42 | 3 | 34 | 57 |
| ANTWERP | 51 | 13 | 16 | 4 | 24 | 10 |
| Sluys | 51 | 18 | 35 | 3 | 23 | 9 |
| *Netherlands.* Bruges | 51 | 12 | 33 | 3 | 13 | 33 |
| Ostend | 51 | 13 | 57 | 2 | 55 | 8 |
| Nieuport | 51 | 7 | 54 | 2 | 45 | 15 |
| Furnes | 51 | 4 | 23 | 2 | 39 | 51 |
| DUNKIRK | 51 | 2 | 9 | 2 | 22 | 38 |
| Berg | 50 | 57 | 43 | 2 | 26 | 41 |
| Gravelines | 50 | 59 | 10 | 2 | 7 | 50 |
| CALAIS | 50 | 57 | 32 | 1 | 51 | 16 |

## VIII. Coasts of FRANCE, SPAIN, and PORTUGAL.

From Calais to Gibraltar.

| | | | | | | |
|---|---|---|---|---|---|---|
| CALAIS | 50 | 57 | 32 | 1 | 51 | 16 |
| Cape Grizness | 50 | 52 | 45 | 1 | 34 | 45 |
| Ambleteuse | 50 | 48 | 13 | 1 | 36 | 16 |
| BOULOGNE | 50 | 43 | 37 | 1 | 36 | 59 |
| Etaples | 50 | 30 | 44 | 1 | 38 | 46 |
| Montreul | 50 | 27 | 42 | 1 | 46 | 2 |
| Rue | 50 | 16 | 19 | 1 | 40 | 16 |
| Le Crotoy | 50 | 12 | 52 | 1 | 27 | 39 |
| Abbeville | 50 | 7 | 4 | 1 | 49 | 58 |
| S. Valery sur Somme | 50 | 11 | 21 | 1 | 37 | 51 |
| Eu | 50 | 2 | 52 | 1 | 15 | 33 |
| DIEPPE Light | 49 | 55 | 34 | 1 | 4 | 44 |
| Ailly Light | 49 | 55 | 17 | 1 | 10 | 32 |
| St. Valery en Caux | 49 | 52 | 12 | 0 | 41 | 40 |
| Fecamp | 49 | 45 | 24 | 0 | 23 | 3 |
| *North Coast of France.* Cape de Caux | 49 | 41 | 0 | 0 | 11 | 15 |
| Cape de la Heve Lt. | 49 | 30 | 42 | 0 | 4 | 15 |
| Havre | 49 | 29 | 14 | 0 | 6 | 38 |
| Harfleur | 49 | 30 | 23 | 0 | 11 | 57 |
| Honfleur | 49 | 25 | 13 | 0 | 14 | 14 |
| PARIS, Observatory | 48 | 50 | 15 | 2 | 20 | 15 |
| Rouen | 49 | 26 | 27 | 1 | 5 | 50 |
| | | | | West | | |
| Caen | 49 | 11 | 12 | 0 | 21 | 38 |
| Bayeux | 49 | 16 | 34 | 0 | 41 | 56 |
| Carentan | 49 | 18 | 17 | 1 | 14 | 50 |
| St. Marcou Island | 49 | 29 | 52 | 1 | 8 | 41 |
| Cape Barfleur Light | 49 | 41 | 45 | 1 | 16 | 15 |
| CHERBOURG | 49 | 38 | 31 | 1 | 37 | 3 |
| Pelee Isle | 49 | 40 | 22 | 1 | 34 | 43 |
| Cape la Hague | 49 | 43 | 33 | 1 | 56 | 15 |
| Alderney I., N.E end | 49 | 44 | 5 | 2 | 8 | 58 |
| — S. W. end | 49 | 42 | 41 | 2 | 13 | 40 |
| CASKETS Lights | 49 | 43 | 50 | 2 | 22 | 0 |
| Guernsey I., St. Peter | 49 | 28 | 15 | 2 | 33 | 18 |
| — St. Martin's Point | 49 | 26 | 25 | 2 | 32 | 35 |
| — Pleinmont Point | 49 | 26 | 35 | 2 | 41 | 26 |
| — Doyle Fort | 49 | 31 | 20 | 2 | 31 | 25 |
| Herm I, N Point | 49 | 30 | 0 | 2 | 28 | 0 |
| Sercq, or Sark I., N. end | 49 | 28 | 0 | 2 | 23 | 0 |

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# TABLE LVI.

## LATITUDES AND LONGITUDES.

| (15) Places. | Lat. N. | Lon. W. |
|---|---|---|
| | ° ′ ″ | ° ′ ″ |
| *North Coast of France.* | | |
| Sercq, or Sark I., S. end | 49 25 25 | 2 23 28 |
| Jersey Island, | | |
| — C. Grosness | 49 16 25 | 2 15 42 |
| — St. Aubin | 49 12 15 | 2 11 0 |
| — St. Heliers | 49 12 0 | 2 6 50 |
| — S. E. Point, Tower | 49 10 57 | 2 2 36 |
| — N.E. Pt., LaCoupe | 49 15 6 | 2 2 20 |
| Chausey Island | 48 52 28 | 1 50 20 |
| St. Germain | 49 13 15 | 1 35 15 |
| Coutances | 49 2 54 | 1 26 23 |
| Granville | 48 50 16 | 1 36 0 |
| Avranche | 48 41 23 | 1 21 32 |
| Mount St. Michael | 48 38 11 | 1 30 57 |
| Pontorson | 48 33 18 | 1 31 17 |
| Cancalle | 48 40 40 | 1 51 15 |
| St. Malo | 48 39 3 | 2 1 11 |
| La Conchée | 48 41 4 | 2 2 33 |
| Dinant | 48 27 6 | 2 1 50 |
| Cape Frehel Light | 48 41 10 | 2 18 36 |
| St. Brieu | 48 31 2 | 2 43 55 |
| Brehat Island | 48 50 5 | 2 55 33 |
| Tregueir | 48 46 54 | 3 13 34 |
| Morlaix | 48 34 50 | 3 53 21 |
| St. Pol de Leon | 48 40 55 | 3 59 51 |
| Blanche Rock | 49 1 25 | 3 57 45 |
| Isle de Bas | 48 46 15 | 4 1 45 |
| St. Anthony's Lights | 48 40 10 | 4 28 45 |
| USHANT LIGHT | 48 28 8 | 5 3 6 |
| *Var. 25° 30′ W.* | | |
| *Western Coast of France.* | | |
| BREST | 48 23 14 | 4 28 45 |
| St. Matthew's Light | 48 19 34 | 4 45 39 |
| Point Ras | 48 0 45 | 4 47 21 |
| Saints Rocks | 48 5 5 | 5 4 45 |
| Point L'Abbé | 47 48 40 | 4 11 45 |
| Quimper | 47 58 29 | 4 5 45 |
| Glenan Islands | 47 44 30 | 4 0 5 |
| Quimperlay | 47 51 53 | 3 33 30 |
| L'ORIENT | 47 45 11 | 3 21 2 |
| *Var. 25° 27′ W.* | | |
| Hennebon | 47 48 1 | 3 17 7 |
| PORT LOUIS | 47 42 47 | 3 20 59 |
| Isle of Groais | 47 38 4 | 3 26 8 |
| QUIBERON, S. Pt. | 47 26 30 | 3 3 45 |
| Belle I., N. end | 47 23 0 | 3 13 45 |
| — S. end | 47 17 17 | 3 4 45 |
| Houat Island | 47 23 32 | 2 56 27 |
| Hedic Island | 47 20 46 | 2 52 16 |
| Aurai | 47 40 4 | 2 49 22 |
| Vannes | 47 39 26 | 2 45 4 |
| Guizande | 47 19 39 | 2 26 6 |
| Croisic | 47 17 43 | 2 30 15 |
| Paimbeuf | 47 17 15 | 2 0 51 |
| NANTES | 47 13 6 | 1 32 44 |
| Bourneuf | 47 2 28 | 1 51 9 |
| Le Pilier | 47 2 32 | 2 21 5 |
| Noirmoutier I., S. Pt. | 47 0 5 | 2 14 7 |
| Bouin Island | 46 58 30 | 2 0 12 |
| Isle D'Yeu, W. Point | 46 42 26 | 2 19 35 |
| St. Gilles | 46 40 0 | 1 51 15 |
| Sables d'Olonne | 46 29 52 | 1 46 50 |
| *Var. 25° 49′ W.* | | |

| (16) Places. | Lat. N. | Lon. W. |
|---|---|---|
| | ° ′ ″ | ° ′ ″ |
| *North and West Coasts of Spain.* | | |
| Roches Bonnes | 46 16 0 | 2 20 45 |
| I. of Ré Light | 46 14 49 | 1 33 25 |
| — St. Martin | 46 12 18 | 1 21 52 |
| ROCHELLE | 46 9 21 | 1 9 40 |
| ROCHEFORT | 45 56 10 | 0 57 31 |
| Oleron Island, Tower | 46 2 51 | 1 24 12 |
| Aix Island | 46 1 38 | 1 10 41 |
| Cordouan Light | 45 35 15 | 1 10 13 |
| Bordeaux | 44 50 14 | 0 33 59 |
| Cape Feret | 44 41 0 | 1 15 16 |
| BAYONNE | 43 29 15 | 1 28 26 |
| St. Jean de Luz | 43 22 30 | 1 40 58 |
| Fuentarabia | 43 21 26 | 1 47 15 |
| Port Passages, ent. to | 43 20 10 | 1 54 30 |
| St. Sebastian | 43 19 30 | 1 58 30 |
| Cape Machichaco | 43 28 10 | 2 39 48 |
| BILBAO | 43 14 30 | 2 43 45 |
| Portugalete | 43 20 10 | 2 58 20 |
| Santona | 43 26 50 | 3 19 20 |
| Santander | 43 28 20 | 3 39 50 |
| Cape Hoyambre | 43 25 10 | 4 12 15 |
| Cape Prieto | 43 28 30 | 4 44 45 |
| Cape de Mar | 43 29 40 | 4 51 35 |
| Cape Lastres | 43 24 0 | 5 13 55 |
| Gijon | 43 35 19 | 5 36 15 |
| Cape Penas | 43 42 16 | 5 46 53 |
| Cape Busto | 43 36 0 | 6 24 0 |
| Ribadeo, entrance | 43 34 45 | 6 59 30 |
| Cape Burela | 43 41 30 | 7 17 0 |
| Port Vivero, entr. | 43 43 45 | 7 33 30 |
| Port de la Estaca | 43 47 50 | 7 38 50 |
| CAPE ORTEGAL | 43 46 40 | 7 50 30 |
| Cape Prior | 43 34 15 | 8 15 45 |
| Ferrol, entrance to | 43 28 0 | 8 16 15 |
| Corunna Light | 43 23 36 | 8 19 35 |
| Cisargas Isles | 43 22 15 | 8 47 30 |
| Cape Villano | 43 11 20 | 9 10 30 |
| Cape Toriana | 43 3 0 | 9 17 0 |
| CAPE FINISTERRE | 42 56 10 | 9 16 15 |
| Cape Corrobedo | 42 33 30 | 9 1 15 |
| Ons Island, N. pt. | 42 24 30 | 8 51 0 |
| VIGO | 42 13 30 | 8 39 45 |
| R. Mino, entrance | 41 52 30 | 8 47 0 |
| *Coast of Portugal.* | | |
| Caminha | 41 52 42 | 8 44 30 |
| Vianna Castle | 41 42 30 | 8 43 10 |
| Villa de Conde | 41 21 20 | 8 35 21 |
| OPORTO, entrance to | 41 8 45 | 8 38 0 |
| Aveiro, entrance to | 40 38 30 | 8 43 0 |
| Coimbra Observatory | 40 12 30 | 8 24 25 |
| Cape Mindego | 40 11 50 | 8 54 0 |
| Figueira | 40 10 0 | 8 51 0 |
| Farilhao | 39 29 15 | 9 23 0 |
| Burlings Island | 39 24 40 | 9 30 22 |
| Cape Carboeiro Light | 39 21 50 | 9 24 30 |
| Lisbon Rock Light | 38 46 30 | 9 30 15 |
| LISBON Observatory | 38 42 35 | 9 8 15 |
| Cape Espichel Light | 38 24 54 | 9 13 0 |
| Setubal or St. Ubes Lt. | 38 28 54 | 8 56 30 |
| Cape Sines | 37 57 30 | 8 52 45 |
| Odemira, Bar of | 37 39 0 | 8 49 0 |

## LATITUDES AND LONGITUDES.

| (17) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Cape St. Vincent | 37 | 2 | 54 | 9 | 0 | 54 |
| *Var.* 23° *W.* | | | | | | |
| Lagos | 37 | 8 | 0 | 8 | 38 | 3 |
| Cape Carvoeiro | 37 | 7 | 0 | 8 | 22 | 30 |
| Cape Santa Maria | 36 | 55 | 24 | 7 | 49 | 50 |
| R. Guadiana, entr. | 37 | 9 | 30 | 7 | 20 | 0 |
| St. Lucar, entrance to | 36 | 44 | 18 | 6 | 24 | 15 |
| Cadiz, Observatory | 36 | 32 | 0 | 6 | 17 | 37 |
| St. Sebastian's Light | 36 | 31 | 10 | 6 | 18 | 50 |
| Cape Trafalgar | 36 | 10 | 15 | 6 | 1 | 52 |
| Tarifa Island Light | 36 | 0 | 50 | 5 | 36 | 15 |
| Gibraltar, | | | | | | |
| — Europa Point | 36 | 6 | 20 | 5 | 20 | 53 |

*Spain.*

## IX. The North Side of the MEDITERRANEAN.

| | | | | | | |
|---|---|---|---|---|---|---|
| Gibraltar, | | | | | | |
| — Europa Point | 36 | 6 | 20 | 5 | 20 | 53 |
| Callera Tower | 36 | 18 | 25 | 5 | 15 | 2 |
| Estapona | 36 | 25 | 10 | 5 | 8 | 52 |
| Cape Morat | 36 | 31 | 0 | 4 | 37 | 55 |
| Malaga Light | 36 | 43 | 22 | 4 | 25 | 2 |
| Salobrina | 36 | 45 | 0 | 3 | 40 | 10 |
| Corchuna Castle | 36 | 41 | 30 | 3 | 26 | 34 |
| Adra Fort | 36 | 44 | 36 | 3 | 1 | 42 |
| Guardias Viejas Cast. | 36 | 41 | 30 | 2 | 52 | 52 |
| Almeria | 36 | 51 | 29 | 2 | 32 | 0 |
| Cape de Gatt, | | | | | | |
| — Coralletes Tower | 36 | 44 | 0 | 2 | 14 | 22 |
| Moxacar Tower | 37 | 6 | 20 | 1 | 54 | 27 |
| Cope Tower | 37 | 25 | 5 | 1 | 33 | 27 |
| Cape Tinosa | 37 | 31 | 10 | 1 | 10 | 22 |
| Carthagena, Obs. | 37 | 35 | 50 | 1 | 0 | 37 |
| Escombrera I. | 37 | 33 | 30 | 0 | 59 | 52 |
| Cape Palos | 37 | 37 | 15 | 0 | 42 | 22 |
| Cape Cervera, | | | | | | |
| — Torre Vieja | 37 | 58 | 55 | 0 | 41 | 27 |
| Cape Santa Pola | 38 | 12 | 5 | 0 | 31 | 42 |
| Alicante | 38 | 20 | 41 | 0 | 29 | 57 |
| Benidorme Tower | 38 | 32 | 10 | 0 | 4 | 42 |
| | | | | East | | |
| Cape Nao | 38 | 44 | 40 | 0 | 10 | 8 |
| Cape St. Martin | 38 | 47 | 0 | 0 | 9 | 30 |
| C. St. Antonio Tower | 38 | 49 | 50 | 0 | 8 | 8 |
| | | | | West | | |
| C. Cullera Tower | 39 | 9 | 0 | 0 | 11 | 17 |
| Valencia, City | 39 | 26 | 40 | 0 | 23 | 2 |
| C. de Canet Tower | 39 | 40 | 0 | 0 | 10 | 52 |
| | | | | East | | |
| C. Oropesa Tower | 40 | 5 | 33 | 0 | 6 | 58 |
| Columbreta Islet | 39 | 56 | 0 | 0 | 42 | 58 |
| Pensicola Point | 40 | 22 | 40 | 0 | 28 | 8 |
| Port Alfaque, | | | | | | |
| — Canal Tower | 40 | 37 | 25 | 0 | 37 | 38 |
| Cape Tortosa, | | | | | | |
| — Buda Island | 40 | 43 | 25 | 0 | 55 | 28 |
| Cape Salou | 41 | 4 | 45 | 1 | 10 | 35 |
| Terragona | 41 | 8 | 50 | 1 | 18 | 23 |

*South and East Coasts of Spain.*

| (18) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Cape Gros Tower | 41 | 9 | 40 | 1 | 27 | 3 |
| Barcelona, Mole | 41 | 22 | 51 | 2 | 10 | 38 |
| Mataro | 41 | 33 | 0 | 2 | 25 | 30 |
| Cape Tosa | 41 | 42 | 50 | 2 | 53 | 58 |
| Palamos, Pt. Grosa | 41 | 51 | 10 | 3 | 3 | 38 |
| Cape St. Sebastian | 41 | 53 | 30 | 3 | 8 | 8 |
| Medas Isles, S. end | 42 | 3 | 10 | 3 | 9 | 23 |
| Cape Norfeo | 42 | 14 | 52 | 3 | 12 | 38 |
| Cape de Creux | 42 | 19 | 45 | 3 | 15 | 48 |
| Cape Servera | 42 | 27 | 15 | 3 | 9 | 0 |
| Port Vendre | 42 | 32 | 5 | 3 | 5 | 57 |
| Elne | 42 | 35 | 44 | 2 | 58 | 23 |
| Perpignan | 42 | 41 | 58 | 2 | 54 | 50 |
| Fort Leucate | 42 | 55 | 30 | 3 | 5 | 10 |
| Narbonne | 43 | 10 | 50 | 3 | 0 | 55 |
| Fort Brecon | 43 | 15 | 20 | 3 | 30 | 35 |
| Agde | 43 | 18 | 40 | 3 | 28 | 15 |
| Cette Light | 43 | 23 | 37 | 3 | 41 | 11 |
| Montpellier, Obs. | 43 | 36 | 16 | 3 | 52 | 46 |
| Aiguemortes Light | 43 | 34 | 2 | 4 | 11 | 31 |
| St. Marie | 43 | 26 | 42 | 4 | 24 | 0 |
| Mouth of the Rhone, | | | | | | |
| — St. Louis Tower | 43 | 22 | 10 | 4 | 47 | 50 |
| Foz | 43 | 26 | 0 | 4 | 54 | 40 |
| C. Couronne | 43 | 18 | 50 | 5 | 1 | 55 |
| Marseilles, Obs. | 43 | 17 | 50 | 5 | 22 | 15 |
| Planier Island Light | 43 | 11 | 50 | 5 | 13 | 30 |
| Cape Roux | 43 | 13 | 0 | 5 | 20 | 0 |
| Cassis Mole | 43 | 12 | 20 | 5 | 33 | 0 |
| Bandol Castle | 43 | 8 | 20 | 5 | 45 | 30 |
| Cape Sicie | 43 | 3 | 6 | 5 | 50 | 15 |
| Toulon | 43 | 7 | 10 | 5 | 55 | 40 |
| Giens Castle | 43 | 2 | 9 | 6 | 7 | 26 |
| Hyeres Islands, | | | | | | |
| — Porquerolles, Fort Langoustier | 42 | 59 | 52 | 6 | 12 | 9 |
| — Porteross, | | | | | | |
| — Gabiniere Rock | 42 | 59 | 6 | 6 | 22 | 40 |
| — Titan, E. point | 43 | 2 | 28 | 6 | 30 | 5 |
| Cape Taillat | 43 | 7 | 45 | 6 | 39 | 10 |
| St. Tropez | 43 | 15 | 20 | 6 | 40 | 10 |
| Frejus | 43 | 26 | 15 | 6 | 44 | 20 |
| Cannes | 43 | 33 | 20 | 7 | 0 | 15 |
| Lerin Is., Ft. Montery | 43 | 31 | 40 | 7 | 2 | 0 |
| Cape Garoupe | 43 | 33 | 0 | 7 | 7 | 30 |
| Antibes | 43 | 34 | 40 | 7 | 7 | 50 |
| River Var, entr. | 43 | 39 | 50 | 7 | 10 | 10 |
| Nice | 43 | 41 | 20 | 7 | 16 | 49 |
| Villa Franca Light | 43 | 40 | 18 | 7 | 19 | 37 |
| Monaco | 43 | 40 | 40 | 7 | 26 | 18 |
| Cape St. Martin | 43 | 43 | 30 | 7 | 32 | 20 |
| Ventimiglia Point | 43 | 44 | 20 | 7 | 42 | 36 |
| Cape St. Remo | 43 | 47 | 30 | 7 | 49 | 53 |
| Cape del Armi | 43 | 49 | 30 | 7 | 53 | 58 |
| Port Maurizio, Mole | 43 | 54 | 49 | 7 | 59 | 36 |
| Cape Oneglia | 43 | 56 | 10 | 8 | 3 | 0 |
| C. de la Melle | 43 | 58 | 10 | 8 | 11 | 5 |
| Gallinara Island | 44 | 2 | 15 | 8 | 13 | 20 |
| Finale Church | 44 | 10 | 50 | 8 | 19 | 15 |
| Cape Noli | 44 | 11 | 0 | 8 | 23 | 30 |

*South Coast of France.*

*Northern Coast of Italy.*

## LATITUDES AND LONGITUDES.

| | (19) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Northern Coast of Italy. | Cape Vado | 44 | 15 | 0 | 8 | 25 | 20 |
| | Savona, Mole | 44 | 18 | 0 | 8 | 28 | 0 |
| | Polla Rock | 44 | 25 | 20 | 8 | 46 | 12 |
| | Genoa Light | 44 | 24 | 22 | 8 | 53 | 5 |
| | Nervi | 44 | 23 | 40 | 9 | 2 | 25 |
| | Cape Porto Fino | 44 | 18 | 27 | 9 | 14 | 30 |
| | Sestri Levante | 44 | 16 | 40 | 9 | 25 | 40 |
| | Cape dell Mesco | 44 | 8 | 20 | 9 | 39 | 40 |
| | Port Venere | 44 | 3 | 30 | 9 | 51 | 30 |
| | Spezzia, Lazaretto | 44 | 4 | 10 | 9 | 52 | 26 |
| | Tino Island | 44 | 2 | 0 | 9 | 52 | 30 |
| West Coast of Italy. | Lavenza Tower | 44 | 1 | 20 | 10 | 4 | 20 |
| | Motrona Tower | 43 | 54 | 30 | 10 | 13 | 0 |
| | Pisa, Observatory | 43 | 43 | 20 | 10 | 24 | 16 |
| | FLORENCE | 43 | 46 | 41 | 11 | 15 | 45 |
| | Viareggia, Mole | 43 | 51 | 35 | 10 | 15 | 0 |
| | Malora Shoal, Tower | 43 | 33 | 0 | 10 | 12 | 45 |
| | Leghorn Light | 43 | 32 | 20 | 10 | 17 | 30 |
| | Vado Tower | 43 | 21 | 35 | 10 | 27 | 0 |
| | Mal de Vetro Shoal | 43 | 20 | 0 | 10 | 21 | 40 |
| | Castagnelto Tower | 43 | 10 | 50 | 10 | 32 | 20 |
| | Piombino, Mole | 42 | 55 | 15 | 10 | 32 | 20 |
| | Fullonica, Mole | 42 | 55 | 6 | 10 | 47 | 0 |
| | Cape Troya Tower | 42 | 47 | 29 | 10 | 45 | 45 |
| | Castiglione Tower | 42 | 44 | 55 | 10 | 55 | 15 |
| | R. Ombrone, entr. | 42 | 37 | 32 | 11 | 2 | 30 |
| | East Formiche | 42 | 37 | 0 | 10 | 53 | 0 |
| | Talamone | 42 | 32 | 10 | 11 | 10 | 30 |
| | San Stefano | 42 | 25 | 35 | 11 | 9 | 45 |
| | Mount Argentaro | 42 | 21 | 45 | 11 | 12 | 15 |
| | Civita Vecchia Light | 42 | 4 | 38 | 11 | 44 | 52 |
| | Cape Linaro | 42 | 1 | 0 | 11 | 49 | 50 |
| | River Tiber, — Fiumicino Light | 41 | 45 | 48 | 12 | 11 | 30 |
| | ROME, St. Peters' | 41 | 54 | 0 | 12 | 26 | 55 |
| | Ardea | 41 | 37 | 0 | 12 | 33 | 0 |
| | Port Anzo, Mole | 41 | 26 | 30 | 12 | 42 | 10 |
| | C. Monte Circello | 41 | 11 | 50 | 13 | 5 | 0 |
| Coast of Naples. | Terracina | 41 | 16 | 0 | 13 | 15 | 0 |
| | Gaeta, Mole | 41 | 12 | 20 | 13 | 35 | 30 |
| | Cape Miseno | 40 | 46 | 20 | 14 | 4 | 55 |
| | Pozzuoli | 40 | 49 | 0 | 14 | 6 | 35 |
| | NAPLES Light | 40 | 50 | 12 | 14 | 15 | 45 |
| | Mount Vesuvius | 40 | 48 | 40 | 14 | 26 | 40 |
| | Castelamare | 40 | 40 | 50 | 14 | 29 | 0 |
| | Cape Campanella | 40 | 33 | 15 | 14 | 19 | 50 |
| | Salerno | 40 | 40 | 0 | 14 | 45 | 20 |
| | Cape Licosa Tower | 40 | 13 | 50 | 14 | 53 | 0 |
| | Policastro | 40 | 2 | 0 | 15 | 23 | 0 |
| | Cetrari | 39 | 29 | 45 | 15 | 56 | 30 |
| | Mount Cocuzza | 39 | 16 | 0 | 16 | 6 | 0 |
| | Cape Suvero Tower | 39 | 2 | 55 | 16 | 8 | 40 |
| | St. Euphemia | 39 | 3 | 0 | 16 | 15 | 0 |
| | Cape Vaticano | 38 | 36 | 30 | 15 | 52 | 0 |
| | Gioja | 38 | 25 | 0 | 15 | 56 | 0 |
| | Scylla Castle | 38 | 14 | 15 | 15 | 41 | 0 |
| | Reggio | 38 | 5 | 45 | 15 | 39 | 0 |
| | Cape dell Armi Tower | 37 | 57 | 30 | 15 | 41 | 35 |
| | Cape Spartivento | 37 | 55 | 45 | 16 | 3 | 15 |

| | (20) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| South Coast of Italy. | Cape Stilo | 38 | 28 | 20 | 16 | 35 | 0 |
| | Squillace | 38 | 48 | 30 | 16 | 28 | 0 |
| | Cape Rizuto | 38 | 57 | 0 | 17 | 0 | 30 |
| | Cape Naa | 39 | 5 | 30 | 17 | 13 | 45 |
| | Cotrona Mole | 39 | 7 | 20 | 17 | 10 | 0 |
| | Strongoli | 39 | 17 | 0 | 17 | 5 | 0 |
| | Point Alice | 39 | 24 | 15 | 17 | 10 | 0 |
| | Pt. del Tronta Tower | 39 | 35 | 0 | 16 | 47 | 10 |
| | Roseto | 39 | 59 | 0 | 16 | 34 | 0 |
| | Tarento, — St. Pietro Island | 40 | 26 | 10 | 17 | 9 | 0 |
| | Gallipoli, — St Andrea Island | 40 | 2 | 0 | 17 | 56 | 30 |
| | C. St. Maria, Convent | 39 | 48 | 40 | 18 | 23 | 0 |
| Adriatic Sea or Gulf of Venice. | Cape Otranto Tower | 40 | 7 | 46 | 18 | 30 | 25 |
| | St. Andrea Tower | 40 | 15 | 30 | 18 | 26 | 30 |
| | Brindisi Fort | 40 | 39 | 27 | 18 | 1 | 20 |
| | Torre della Testa | 40 | 41 | 0 | 17 | 54 | 45 |
| | Monopoli | 40 | 57 | 19 | 17 | 20 | 30 |
| | Polignano | 40 | 59 | 50 | 17 | 15 | 0 |
| | Mola | 41 | 4 | 10 | 17 | 7 | 45 |
| | Bari, Mole | 41 | 8 | 30 | 16 | 54 | 15 |
| | Malfetto, Mole | 41 | 13 | 10 | 16 | 38 | 0 |
| | Trani | 41 | 17 | 30 | 16 | 27 | 25 |
| | Barletta Light | 41 | 20 | 25 | 16 | 19 | 0 |
| | Torre di Rivoli | 41 | 29 | 13 | 15 | 57 | 5 |
| | Manfredonia, Mole | 41 | 37 | 38 | 15 | 56 | 14 |
| | Viesti, Croce Island | 41 | 52 | 35 | 16 | 11 | 30 |
| | Perchichi | 41 | 56 | 42 | 16 | 1 | 10 |
| | Varano Towers | 41 | 55 | 23 | 15 | 48 | 56 |
| | Mileto Tower | 41 | 55 | 56 | 15 | 38 | 42 |
| | Campo Marino | 41 | 57 | 49 | 15 | 2 | 25 |
| | Termoli | 42 | 0 | 25 | 15 | 0 | 26 |
| | Petacchiato | 42 | 1 | 3 | 14 | 52 | 13 |
| | Vasto | 42 | 6 | 30 | 14 | 43 | 8 |
| | Point Penna | 42 | 10 | 20 | 14 | 44 | 0 |
| | Ortona, Mole | 42 | 20 | 30 | 14 | 26 | 30 |
| | Francavilla | 42 | 24 | 5 | 14 | 19 | 0 |
| | Castelamare | 42 | 28 | 0 | 14 | 12 | 24 |
| | Silvi | 42 | 33 | 14 | 14 | 6 | 48 |
| | Mt. Pegnano, Church | 42 | 40 | 32 | 14 | 1 | 0 |
| | Colonella | 42 | 52 | 20 | 13 | 53 | 5 |
| | Rio Tronto, Tower | 42 | 53 | 45 | 13 | 55 | 40 |
| | Grottamare | 42 | 59 | 49 | 13 | 52 | 50 |
| | Pedaso | 43 | 5 | 59 | 13 | 51 | 1 |
| | Fermo | 43 | 9 | 35 | 13 | 44 | 0 |
| | Cittanova | 43 | 19 | 0 | 13 | 44 | 30 |
| | Loretto, Steeple | 43 | 26 | 36 | 13 | 37 | 0 |
| | Ancona, Light | 43 | 37 | 42 | 13 | 30 | 26 |
| | Sinigalia Light | 43 | 43 | 2 | 13 | 13 | 11 |
| | Fano Light | 43 | 51 | 0 | 13 | 1 | 10 |
| | Pesaro Light | 43 | 55 | 42 | 12 | 54 | 39 |
| | Rimini Light | 44 | 4 | 35 | 12 | 34 | 10 |
| | Cervia Tower | 44 | 16 | 0 | 12 | 21 | 7 |
| | Ravenna Tower | 44 | 25 | 25 | 12 | 12 | 11 |
| | Goro | 44 | 50 | 31 | 12 | 19 | 30 |
| | Point del Maestra | 44 | 58 | 45 | 12 | 31 | 40 |
| | Port Brondolo, Fort | 45 | 10 | 10 | 12 | 19 | 25 |
| | Chioggia | 45 | 13 | 26 | 12 | 17 | 55 |
| | Palestrina Church | 45 | 15 | 40 | 12 | 19 | 15 |

## LATITUDES AND LONGITUDES.

| (21) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Port Malamoco, | | | | | | |
| — Fort Alberoni | 45 | 20 | 50 | 12 | 20 | 30 |
| VENICE, St. Mark's Tower | 45 | 25 | 53 | 12 | 20 | 31 |
| Caorle | 45 | 35 | 45 | 12 | 53 | 31 |
| R. Tagliamento, entr. | 45 | 38 | 40 | 13 | 3 | 45 |
| Port Lignano | 45 | 40 | 56 | 13 | 7 | 32 |
| Grado | 45 | 40 | 18 | 13 | 23 | 10 |
| TRIESTE Castle | 45 | 38 | 37 | 13 | 46 | 27 |
| Cape d' Istria | 45 | 32 | 17 | 13 | 43 | 58 |
| Pirano, Steeple | 45 | 30 | 30 | 13 | 34 | 20 |
| Point Salvore Light | 45 | 29 | 45 | 13 | 33 | 25 |
| Cittanova | 45 | 18 | 51 | 13 | 33 | 35 |
| Parenzo | 45 | 13 | 37 | 13 | 35 | 40 |
| Rovigno | 45 | 4 | 56 | 13 | 37 | 57 |
| Pola, St. Francis Ch. | 44 | 52 | 16 | 13 | 50 | 39 |
| Cape Promontore | 44 | 46 | 0 | 13 | 55 | 10 |
| Albona Steeple | 45 | 4 | 56 | 14 | 7 | 30 |
| Fianona | 45 | 7 | 50 | 14 | 10 | 30 |
| Fiume, Clock | 45 | 19 | 36 | 14 | 26 | 30 |
| Porto Re | 45 | 15 | 50 | 14 | 33 | 35 |
| Segna, Mole | 44 | 59 | 40 | 14 | 53 | 40 |
| Karlopago, Mole | 44 | 31 | 40 | 15 | 4 | 30 |
| Nona | 44 | 14 | 36 | 15 | 10 | 34 |
| Zara, St. Simons Ch. | 44 | 6 | 56 | 15 | 12 | 58 |
| Zara Vecchia | 43 | 56 | 19 | 15 | 26 | 33 |
| Sabenico | 43 | 44 | 13 | 15 | 53 | 28 |
| Trau, Steeple | 43 | 30 | 55 | 16 | 15 | 10 |
| Spalatro, Paulini To. | 43 | 30 | 25 | 16 | 26 | 20 |
| Mount Borak | 43 | 25 | 53 | 16 | 43 | 58 |
| Marcaska | 43 | 17 | 32 | 17 | 1 | 5 |
| RAGUSA, Mole | 42 | 38 | 10 | 18 | 6 | 46 |
| Markana I., Tower | 42 | 34 | 15 | 18 | 11 | 10 |
| Melonta | 42 | 27 | 7 | 18 | 25 | 0 |
| Kattaro, | | | | | | |
| — Point Ostro | 42 | 23 | 20 | 18 | 31 | 16 |
| Budua, Greek Steeple | 42 | 16 | 33 | 18 | 50 | 27 |
| Antivari, Point Ledo | 42 | 2 | 25 | 19 | 6 | 25 |
| Dulcigno, Mole | 41 | 53 | 45 | 19 | 11 | 40 |
| Cape Rodoni | 41 | 37 | 40 | 19 | 28 | 10 |
| Cape Pali | 41 | 23 | 0 | 19 | 24 | 30 |
| Durazzo Mole | 41 | 17 | 32 | 19 | 27 | 46 |
| Cape Laghi | 41 | 10 | 10 | 19 | 26 | 0 |
| Aulona or Valona, | | | | | | |
| — Custom House | 40 | 27 | 15 | 19 | 26 | 20 |
| Saseno Island, S. Pt. | 40 | 30 | 20 | 19 | 14 | 10 |
| Cape Linguetta | 40 | 25 | 20 | 19 | 14 | 40 |
| Port Palermo | 40 | 2 | 58 | 19 | 48 | 10 |
| Cape Kiephali | 39 | 55 | 40 | 19 | 53 | 30 |
| Parga, Town | 39 | 16 | 30 | 20 | 23 | 25 |
| Kastrosikia | 39 | 6 | 0 | 20 | 38 | 35 |
| Previsa, | | | | | | |
| — Fort Pantokratera | 38 | 56 | 10 | 20 | 44 | 0 |
| Dragomestre | 38 | 32 | 45 | 21 | 6 | 0 |
| Skropha Cove | 38 | 18 | 55 | 21 | 8 | 50 |
| Oxia Island, S. end | 38 | 17 | 20 | 21 | 6 | 15 |
| Messalongia Fort | 38 | 20 | 30 | 21 | 24 | 20 |
| Point Bakari | 38 | 17 | 15 | 21 | 30 | 40 |
| Roumelia Castle | 38 | 19 | 15 | 21 | 48 | 30 |
| Lepanto | 38 | 21 | 45 | 21 | 51 | 0 |

*Adriatic Sea or Gulf of Venice.*

*Albania.*

| (22) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| CORINTH | 37 | 53 | 37 | 22 | 52 | 5 |
| Morea Castle | 38 | 18 | 20 | 21 | 49 | 30 |
| Patrass, Mole | 38 | 14 | 25 | 21 | 46 | 20 |
| Cape Papas | 38 | 12 | 40 | 21 | 25 | 30 |
| Konopoli Rock | 38 | 5 | 30 | 21 | 22 | 15 |
| Tornisi Castle | 37 | 53 | 45 | 21 | 9 | 30 |
| Cape Catakolo | 37 | 38 | 12 | 21 | 20 | 0 |
| Arcadia Town | 37 | 14 | 15 | 21 | 41 | 50 |
| Cape Konello | 37 | 12 | 0 | 21 | 36 | 30 |
| Prodano Island, Peak | 37 | 1 | 50 | 21 | 34 | 10 |
| Navarino Castle | 36 | 52 | 30 | 21 | 41 | 0 |
| Modon Light | 36 | 48 | 5 | 21 | 41 | 8 |
| Sapienza Island, S.Pt. | 36 | 42 | 30 | 21 | 41 | 0 |
| Cabrera, S. E. Point | 36 | 40 | 0 | 21 | 47 | 30 |
| Cape Gallo | 36 | 41 | 20 | 21 | 54 | 56 |
| Venetico Island, mid. | 36 | 40 | 10 | 21 | 55 | 15 |
| Coron or Koron | 36 | 47 | 26 | 22 | 0 | 0 |
| Kalomata | 36 | 59 | 45 | 22 | 8 | 25 |
| Cape Kephali | 36 | 53 | 0 | 22 | 9 | 0 |
| Port Djimovo | 36 | 39 | 0 | 22 | 23 | 6 |
| CapeGrosso, S.W. Pt. | 36 | 28 | 0 | 22 | 21 | 0 |
| Cape Matapan | 36 | 21 | 30 | 22 | 28 | 0 |
| Port Pagagna, N. Pt | 36 | 38 | 0 | 22 | 30 | 30 |
| Eurotas River, entr., | | | | | | |
| — Vasili Castle | 36 | 48 | 0 | 22 | 35 | 0 |
| Rupina Tower | 36 | 40 | 30 | 22 | 48 | 15 |
| Cape St. Angelo | 36 | 26 | 0 | 23 | 12 | 30 |
| Napoli di Malvasia, | | | | | | |
| — Fort | 36 | 44 | 0 | 23 | 2 | 0 |
| Nauplia or Napoli di Romania | 37 | 33 | 50 | 22 | 47 | 30 |
| ATHENS, | | | | | | |
| — Philopapus | 37 | 57 | 45 | 23 | 43 | 30 |
| Cape Colonna | 37 | 39 | 15 | 24 | 1 | 34 |
| Cape Marathon | 38 | 10 | 20 | 24 | 4 | 45 |
| Negropont | 38 | 33 | 36 | 23 | 42 | 0 |
| Cape Doro | 38 | 9 | 30 | 24 | 36 | 0 |
| Cape Kili | 38 | 39 | 30 | 24 | 10 | 0 |
| Mount Delphi | 38 | 37 | 43 | 23 | 51 | 18 |
| Mount Pelion | 39 | 26 | 17 | 23 | 2 | 55 |
| Mount Olympus | 40 | 4 | 32 | 22 | 21 | 53 |
| Salonica, Mill | 40 | 38 | 47 | 22 | 57 | 13 |
| Cape Drepano | 39 | 56 | 53 | 23 | 57 | 17 |
| Mount Athos | 40 | 9 | 29 | 24 | 19 | 53 |
| Cape Maori | 40 | 51 | 0 | 25 | 45 | 0 |
| Cape Paxi | 40 | 36 | 0 | 26 | 5 | 0 |
| Cape Stilia | 40 | 19 | 0 | 26 | 13 | 0 |
| Entr. to Dardanelles, | | | | | | |
| — Europa Castle | 40 | 2 | 25 | 26 | 12 | 15 |
| Gallipoli Light | 40 | 24 | 30 | 26 | 39 | 45 |
| Rodosto | 40 | 59 | 34 | 27 | 30 | 0 |
| Heraclia | 40 | 59 | 3 | 27 | 57 | 0 |
| Point Stephano | 40 | 57 | 0 | 28 | 50 | 0 |
| CONSTANTINOPLE, | | | | | | |
| — Mosque of St. Soph. | 41 | 0 | 12 | 28 | 59 | 2 |
| Scutari, | | | | | | |
| — Leander's Tower | 41 | 1 | 0 | 29 | 0 | 30 |
| Princes Isles, westm. | 40 | 52 | 0 | 28 | 59 | 0 |
| Nicomedia | 40 | 45 | 0 | 30 | 0 | 0 |

*Eastern Coast of Greece.*

*Sea of Marmora.*

## LATITUDES AND LONGITUDES.

| (23) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Cape Karabouga | 40 | 28 | 0 | 27 | 16 | 0 |
| Marmara I., S.W. end | 40 | 37 | 4 | 27 | 30 | 50 |
| — East end, Light | 40 | 38 | 0 | 27 | 46 | 0 |

### X. The BLACK SEA and SEA of AZOF.

| | | | | | | |
|---|---|---|---|---|---|---|
| Bosphorus, | | | | | | |
| — European Light | 41 | 14 | 10 | 29 | 7 | 0 |
| Cape Kouri | 41 | 52 | 43 | 28 | 2 | 57 |
| Bourgas, City | 42 | 29 | 20 | 27 | 27 | 57 |
| — St. John's I. | 42 | 25 | 54 | 27 | 41 | 22 |
| Cape Emeneh | 42 | 41 | 40 | 27 | 53 | 30 |
| VARNA, S. E. bastion | 43 | 12 | 15 | 27 | 56 | 10 |
| Cape Calaghriah | 43 | 21 | 25 | 28 | 27 | 5 |
| Mouths of the Danube | | | | | | |
| — Khas Elias, entr. | 44 | 52 | 45 | 29 | 36 | 25 |
| — Soulineh, Light | 45 | 10 | 15 | 29 | 40 | 50 |
| Serpent's Island | 45 | 15 | 0 | 30 | 10 | 55 |
| Ackerman | 46 | 12 | 0 | 30 | 24 | 0 |
| C. Fontan, Light | 46 | 22 | 20 | 30 | 43 | 35 |
| ODESSA, Lazaretto | 46 | 28 | 54 | 30 | 43 | 22 |
| Berezan I., Fort | 46 | 35 | 34 | 31 | 22 | 42 |
| Otchakof | 46 | 36 | 25 | 31 | 30 | 50 |
| Nicolaef, Obs. | 46 | 58 | 55 | 32 | 0 | 37 |
| Kherson | 46 | 37 | 46 | 32 | 38 | 33 |
| Tendra I., Light | 46 | 21 | 40 | 31 | 29 | 20 |
| Perecop | 46 | 8 | 57 | 33 | 42 | 9 |
| Cape Tarkan, Light | 45 | 21 | 35 | 32 | 31 | 15 |
| Koslof, Fort | 45 | 9 | 0 | 33 | 18 | 15 |
| C Chersoneseus, Light | 44 | 34 | 25 | 33 | 20 | 45 |
| Sevastopol, Steeple | 44 | 35 | 25 | 33 | 31 | 30 |
| C. Saritche | 44 | 22 | 0 | 33 | 44 | 15 |
| Alouchti | 44 | 41 | 0 | 34 | 25 | 55 |
| Caffa | 45 | 1 | 37 | 35 | 23 | 28 |
| Cape Karak | 45 | 2 | 25 | 36 | 18 | 0 |
| Kertch | 45 | 21 | 29 | 36 | 28 | 49 |
| Jenikaleh | 45 | 21 | 12 | 36 | 36 | 11 |
| Taman | 45 | 13 | 40 | 36 | 43 | 45 |
| Arabat | 45 | 21 | 0 | 35 | 31 | 0 |
| Marionpol | 47 | 6 | 0 | 37 | 25 | 0 |
| Taganrok, Fort | 47 | 12 | 40 | 38 | 39 | 0 |
| Azof | 47 | 9 | 0 | 39 | 8 | 0 |
| Sougoudjak | 44 | 39 | 0 | 37 | 46 | 35 |
| Ghelenjik | 44 | 30 | 30 | 38 | 7 | 0 |
| Soukourn Kaleh | 42 | 59 | 20 | 41 | 0 | 8 |
| Poti or Phas, | | | | | | |
| — New Fort | 42 | 7 | 30 | 41 | 39 | 55 |
| C. Batoum, Tower | 41 | 40 | 0 | 41 | 35 | 25 |
| Rizeh | 41 | 2 | 25 | 40 | 30 | 10 |
| Trebizonde | 41 | 1 | 0 | 39 | 44 | 52 |
| Tiriboli | 41 | 1 | 0 | 38 | 49 | 10 |
| Keresoun | 40 | 57 | 10 | 38 | 23 | 40 |
| Cape Vona | 41 | 7 | 5 | 37 | 48 | 40 |
| Eunieh | 41 | 10 | 0 | 37 | 18 | 0 |
| R. Kizel Ermak, entr. | 41 | 45 | 0 | 35 | 56 | 0 |
| SINOPE | 42 | 2 | 30 | 35 | 9 | 45 |
| Cape Indjeh | 42 | 7 | 57 | 34 | 56 | 25 |

| (24) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Cape Kerempeh | 42 | 2 | 1 | 33 | 19 | 5 |
| Amasserah | 41 | 45 | 27 | 32 | 21 | 15 |
| Cape Kilimoli | 41 | 32 | 0 | 31 | 51 | 0 |
| Heracles, Light | 41 | 17 | 8 | 31 | 24 | 47 |
| Cape Kerpeli | 41 | 14 | 0 | 30 | 15 | 0 |
| Bosphorus, Asia Light | 41 | 13 | 0 | 29 | 3 | 0 |

### XI. East and South Coasts of the MEDITERRANEAN.

| | | | | | | |
|---|---|---|---|---|---|---|
| Cape Janissary | 39 | 59 | 30 | 26 | 12 | 30 |
| Troy, Ruins of | 39 | 52 | 0 | 26 | 11 | 0 |
| Mount Ida | 39 | 45 | 45 | 26 | 42 | 0 |
| Cape Baba | 39 | 30 | 0 | 26 | 4 | 30 |
| Adramytti | 39 | 34 | 50 | 26 | 57 | 0 |
| SMYRNA | 38 | 25 | 36 | 27 | 6 | 45 |
| Cape Karabouroun | 38 | 41 | 30 | 26 | 21 | 0 |
| Cape Blanco | 38 | 17 | 0 | 26 | 11 | 0 |
| Cape Koraka | 38 | 6 | 0 | 26 | 34 | 20 |
| Sighajik, Island | 38 | 11 | 54 | 26 | 44 | 53 |
| *Var.* 12° 45′ *W.* | | | | | | |
| Scalanuova, | | | | | | |
| — Koosh Adassi I. | 37 | 50 | 30 | 27 | 15 | 0 |
| Cape St. Mary | 37 | 39 | 0 | 27 | 2 | 0 |
| Boudroun, Tower | 37 | 1 | 21 | 27 | 25 | 18 |
| Cape Crio | 36 | 40 | 46 | 27 | 21 | 6 |
| Cape Marmorice | 36 | 41 | 0 | 28 | 18 | 0 |
| Karagatch, | | | | | | |
| — Linaro Island | 36 | 43 | 0 | 28 | 26 | 0 |
| Gulf of Makri, | | | | | | |
| — Cape Iria | 36 | 32 | 40 | 29 | 2 | 0 |
| Seven Capes, S. Pt. | 36 | 18 | 0 | 29 | 15 | 0 |
| Patara | 36 | 14 | 30 | 29 | 28 | 50 |
| Cape Khilidonia | 36 | 12 | 0 | 30 | 26 | 6 |
| Cape Avova | 36 | 35 | 8 | 30 | 38 | 25 |
| Adalia | 36 | 52 | 10 | 30 | 45 | 0 |
| Cape Karaboornoo | 36 | 38 | 0 | 31 | 43 | 10 |
| Cape Anamour | 36 | 0 | 50 | 32 | 50 | 56 |
| Cape Cavaliere | 36 | 7 | 50 | 33 | 42 | 36 |
| P. Lissan el Kabeh | 36 | 13 | 45 | 33 | 59 | 10 |
| Karadash boornoo | 36 | 32 | 40 | 35 | 21 | 26 |
| Ayas | 36 | 46 | 10 | 35 | 48 | 0 |
| Scanderoon or | | | | | | |
| Alexandretta | 36 | 35 | 27 | 36 | 15 | 0 |
| Cape Khynzyr | 36 | 19 | 0 | 35 | 49 | 30 |
| ANTIOCH | 36 | 11 | 0 | 36 | 9 | 30 |
| Cape Possidi | 35 | 52 | 10 | 35 | 50 | 55 |
| Latakia | 35 | 30 | 30 | 35 | 47 | 55 |
| Tortosa | 34 | 50 | 25 | 35 | 51 | 50 |
| Tripoli | 34 | 26 | 22 | 35 | 51 | 32 |
| Cape Bairout | 33 | 49 | 45 | 35 | 28 | 0 |
| Seydi or Sidon | 33 | 34 | 5 | 35 | 23 | 50 |
| Tsour or Tyre | 33 | 17 | 0 | 35 | 14 | 35 |
| Acre | 32 | 54 | 35 | 35 | 6 | 20 |
| Jaffa | 32 | 3 | 25 | 34 | 46 | 10 |
| JERUSALEM | 31 | 47 | 47 | 35 | 20 | 15 |
| Ascalon, Ruins | 31 | 39 | 0 | 34 | 32 | 55 |

## LATITUDES AND LONGITUDES.

| (23) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Egypt.* | | | | | | |
| El Arish, Fort | 31 | 5 | 30 | 33 | 48 | 25 |
| Damietta | 31 | 25 | 43 | 31 | 49 | 30 |
| CAIRO | 30 | 3 | 20 | 31 | 18 | 15 |
| Rosetta | 31 | 25 | 0 | 30 | 28 | 20 |
| Aboukir, Tower | 31 | 20 | 35 | 30 | 6 | 0 |
| ALEXANDRIA, Light | 31 | 12 | 35 | 29 | 53 | 27 |
| — Point Eunostos | 31 | 11 | 31 | 29 | 51 | 28 |
| *Var.* 10° 55′ *W.* | | | | | | |
| Arabs Tower | 30 | 58 | 15 | 29 | 34 | 20 |
| Ras al Kanais | 31 | 15 | 32 | 27 | 52 | 25 |
| Ishailoo Rocks | 31 | 31 | 17 | 26 | 39 | 44 |
| Tifarh Rocks | 31 | 36 | 0 | 26 | 16 | 0 |
| Sallouine | 31 | 28 | 35 | 25 | 10 | 0 |
| Cape Luko or Ras al Milhr | 31 | 54 | 0 | 25 | 3 | 0 |
| Toubrouk | 32 | 3 | 51 | 24 | 3 | 33 |
| Bomba, Tank Point | 32 | 23 | 30 | 23 | 11 | 20 |
| — Bhurda Island | 32 | 22 | 36 | 23 | 16 | 23 |
| *Var.* 14° 55′ *W.* | | | | | | |
| Cape Razatin | 32 | 34 | 0 | 23 | 13 | 10 |
| Derna | 32 | 45 | 59 | 22 | 40 | 45 |
| Cyrene, Theatre | 32 | 49 | 38 | 21 | 48 | 30 |
| Cape Razat | 32 | 55 | 56 | 21 | 38 | 54 |
| Pt. Tolometa, Old T. | 32 | 42 | 29 | 20 | 54 | 50 |
| Teukera | 32 | 32 | 20 | 20 | 33 | 44 |
| Bengasi, Castle | 32 | 6 | 50 | 20 | 2 | 56 |
| Karkora, Rock | 31 | 28 | 20 | 20 | 0 | 10 |
| Sahan | 31 | 2 | 44 | 20 | 12 | 0 |
| Gharra Island | 30 | 47 | 20 | 19 | 57 | 24 |
| Marsa Braiga | 30 | 23 | 29 | 19 | 39 | 30 |
| *Tripoli.* Sookren | 30 | 16 | 0 | 19 | 18 | 10 |
| Bushaifa Island | 30 | 17 | 40 | 19 | 11 | 30 |
| Linoofe | 30 | 23 | 51 | 18 | 43 | 56 |
| Kudia | 30 | 44 | 13 | 18 | 17 | 50 |
| Boosaida | 30 | 59 | 30 | 17 | 39 | 21 |
| Shaiwsha | 31 | 9 | 30 | 17 | 10 | 0 |
| Zaphran | 31 | 12 | 30 | 16 | 41 | 29 |
| Djerid | 31 | 23 | 41 | 15 | 52 | 10 |
| Isa, Ruins | 31 | 32 | 50 | 15 | 31 | 46 |
| Pt. Kharra, Date Tree | 32 | 10 | 0 | 15 | 24 | 48 |
| Cape Mesurata, | | | | | | |
| — Bushaifa Marabut | 32 | 21 | 26 | 15 | 16 | 35 |
| — North Extreme | 32 | 25 | 25 | 15 | 10 | 0 |
| Ziliten | 32 | 29 | 51 | 14 | 33 | 48 |
| Lebida | 32 | 39 | 43 | 14 | 14 | 0 |
| Ras al Hamra | 32 | 47 | 15 | 13 | 53 | 0 |
| Tajoura Point | 32 | 54 | 56 | 13 | 21 | 0 |
| TRIPOLI, Castle | 32 | 53 | 56 | 13 | 10 | 58 |
| *Var.* 16° 35′ *W.* | | | | | | |
| Old Tripoli, Fort | 32 | 48 | 51 | 12 | 25 | 29 |
| Zoara | 33 | 55 | 10 | 12 | 3 | 55 |
| Jerba I., Zug Castle | 33 | 53 | 0 | 10 | 53 | 20 |
| Kabes | 33 | 52 | 40 | 10 | 4 | 15 |
| Karkenna Islands, | | | | | | |
| — Kusha Island | 34 | 49 | 0 | 11 | 18 | 40 |
| *Tunis.* Cape Burdj. Kadija | 35 | 9 | 30 | 11 | 10 | 0 |
| Mehedia, Ruins | 35 | 31 | 15 | 11 | 7 | 15 |
| Al Kuriat Is., N. end | 35 | 48 | 0 | 11 | 4 | 0 |
| Monasteer | 35 | 44 | 30 | 10 | 51 | 30 |
| Soussa, Mole | 35 | 47 | 59 | 10 | 39 | 0 |

| (26) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Herklah | 35 | 59 | 10 | 10 | 30 | 0 |
| Hammamet | 36 | 23 | 0 | 10 | 38 | 30 |
| Kalibia | 36 | 49 | 30 | 11 | 8 | 30 |
| Cape Bon, N. Pt. | 37 | 6 | 0 | 11 | 2 | 25 |
| Zembra Island mid. | 37 | 8 | 30 | 10 | 48 | 30 |
| Cape Zaphran | 36 | 52 | 0 | 10 | 36 | 0 |
| Goletta, entr. | 36 | 48 | 0 | 10 | 16 | 30 |
| TUNIS, City | 36 | 46 | 40 | 10 | 6 | 15 |
| *Tunis.* Cape Carthage | 36 | 52 | 10 | 10 | 19 | 45 |
| Pt. Farina | 37 | 10 | 55 | 10 | 14 | 30 |
| Piana Island | 37 | 11 | 0 | 10 | 18 | 0 |
| Cane Rocks | 37 | 22 | 0 | 10 | 3 | 0 |
| Cape Zibeib | 37 | 16 | 30 | 10 | 0 | 30 |
| Bizerta, Mole | 37 | 16 | 30 | 9 | 49 | 20 |
| Cape Bianco | 37 | 20 | 0 | 9 | 48 | 0 |
| Cape Serrat | 37 | 13 | 30 | 9 | 9 | 30 |
| Galita Island | 37 | 30 | 50 | 8 | 54 | 0 |
| Sorelli Rocks | 37 | 25 | 0 | 8 | 37 | 0 |
| Cape Negro | 37 | 5 | 0 | 8 | 55 | 0 |
| Tabarca Island | 36 | 56 | 25 | 8 | 42 | 30 |
| Cape Ross | 36 | 55 | 0 | 8 | 12 | 50 |
| Cape Mavera | 36 | 58 | 0 | 7 | 50 | 0 |
| Bona, Town | 36 | 53 | 30 | 7 | 48 | 20 |
| Ras Shailouk | 37 | 2 | 30 | 7 | 33 | 5 |
| Ras Hadeed or | | | | | | |
| Cape Ferro | 37 | 5 | 30 | 7 | 11 | 15 |
| Ras al Frigana | 37 | 7 | 0 | 6 | 28 | 45 |
| Jijeli | 36 | 50 | 30 | 5 | 47 | 0 |
| Cape Carbon | 36 | 47 | 0 | 5 | 9 | 40 |
| Pisan Rocks | 36 | 49 | 30 | 5 | 2 | 30 |
| C. Dellys or Tedilles | 36 | 55 | 20 | 4 | 14 | 15 |
| *Algiers.* Cape Bingut | 36 | 54 | 15 | 3 | 58 | 15 |
| Cape Matafou | 36 | 51 | 0 | 3 | 12 | 0 |
| ALGIERS, Light | 36 | 48 | 30 | 3 | 1 | 20 |
| Sidi Ferruch Bay | 36 | 48 | 0 | 2 | 53 | 0 |
| Zerzahal | 36 | 35 | 0 | 2 | 2 | 0 |
| Cape Tennes | 36 | 33 | 0 | 1 | 21 | 0 |
| Palomas Island | 36 | 25 | 0 | 0 | 56 | 0 |
| Cape Kulmeta | 36 | 16 | 0 | 0 | 27 | 0 |
| | | | | | West | |
| Cape Ferrat | 35 | 55 | 0 | 0 | 18 | 0 |
| Oran, Castle | 35 | 44 | 27 | 0 | 43 | 0 |
| Cape Falcon | 35 | 48 | 0 | 0 | 48 | 0 |
| Habiba Island | 35 | 41 | 0 | 1 | 8 | 0 |
| Cape Figalo | 35 | 31 | 0 | 1 | 10 | 0 |
| Cape Guardia | 35 | 18 | 0 | 1 | 41 | 0 |
| Zaphran Islands, mid. | 35 | 11 | 0 | 2 | 24 | 0 |
| Melilla | 35 | 18 | 15 | 2 | 58 | 0 |
| Cape Tres Forcas | 35 | 27 | 55 | 2 | 57 | 40 |
| Al Buzema, | | | | | | |
| — Garrison Rock | 35 | 16 | 30 | 3 | 47 | 0 |
| *Morocco.* Penon de Velez | 35 | 11 | 0 | 4 | 15 | 0 |
| Pescadores | 35 | 16 | 0 | 4 | 45 | 0 |
| Pt. Mazari or Tetuan | 35 | 33 | 15 | 5 | 15 | 20 |
| Tetuan, Tower | 35 | 37 | 0 | 5 | 18 | 30 |
| Cape Negro | 35 | 41 | 30 | 5 | 17 | 0 |
| Ceuta, | | | | | | |
| — Almina Pt. | 35 | 54 | 4 | 5 | 17 | 0 |
| Tangier | 35 | 47 | 0 | 5 | 49 | 30 |
| Cape Spartel | 35 | 47 | 15 | 5 | 54 | 25 |

## LATITUDES AND LONGITUDES.

### XII. Islands in the MEDITERRANEAN, GULF OF VENICE, and ARCHIPELAGO.

| | (27) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| | Alboran Isle | 35 | 57 | 0 | 3 | 0 | 40 |
| *The Baleric Islands.* | Formentera, | | | | East | | |
| | — Point del Aguila | 38 | 40 | 30 | 1 | 26 | 58 |
| | — La Mola or E. Pt. | 38 | 42 | 10 | 1 | 35 | 23 |
| | Iviza or Ivica, | | | | | | |
| | — Point Denserra | 39 | 6 | 22 | 1 | 31 | 53 |
| | — Cape Nono | 39 | 2 | 50 | 1 | 23 | 0 |
| | — Bedra Island | 38 | 51 | 0 | 1 | 17 | 0 |
| | — Cape Falcon | 38 | 50 | 40 | 1 | 24 | 20 |
| | Cabrera Island, | | | | | | |
| | — Point Anciola | 39 | 7 | 15 | 2 | 58 | 0 |
| | Majorca or Mallorca, | | | | | | |
| | — Point Rebagada | 39 | 34 | 25 | 2 | 23 | 13 |
| | — Cape Cala Figuera | 39 | 25 | 30 | 2 | 33 | 0 |
| | — Palma, Town | 39 | 34 | 4 | 2 | 39 | 0 |
| | — Cape Salinas | 39 | 15 | 45 | 3 | 5 | 3 |
| | — Cape de Pera | 39 | 42 | 20 | 3 | 30 | 18 |
| | — Cape Formenton | 39 | 57 | 15 | 3 | 17 | 58 |
| | Minorca, | | | | | | |
| | — Cape Dartuch | 39 | 56 | 0 | 3 | 51 | 0 |
| | — Cape Minorca | 40 | 2 | 50 | 3 | 50 | 43 |
| | — Cape Mola, Mahon | 39 | 52 | 32 | 4 | 24 | 15 |
| | — South E. Point | 39 | 47 | 0 | 4 | 21 | 22 |
| *Sardinia.* | Cape del Testa or Longo Sardo | 41 | 15 | 0 | 9 | 7 | 0 |
| | Asinara I., N. E. end | 41 | 8 | 5 | 8 | 18 | 18 |
| | Cape Falconi | 40 | 59 | 13 | 8 | 10 | 30 |
| | Cape Argentara | 40 | 45 | 0 | 8 | 4 | 20 |
| | Cape Caccia | 40 | 33 | 30 | 8 | 5 | 0 |
| | Alghero, Church | 40 | 32 | 50 | 8 | 15 | 35 |
| | Cape Marargui | 40 | 19 | 25 | 8 | 20 | 15 |
| | Mal de Ventri Island | 39 | 59 | 0 | 8 | 16 | 0 |
| | Coscio di Donna Rock | 39 | 52 | 25 | 8 | 14 | 0 |
| | Cape St. Marco | 39 | 50 | 50 | 8 | 24 | 0 |
| | Cape Frasco | 39 | 45 | 40 | 8 | 25 | 0 |
| | Oristano, Steeple | 39 | 53 | 55 | 8 | 33 | 40 |
| | Cape Pecora | 39 | 27 | 0 | 8 | 21 | 0 |
| | St. Pietro Island, | | | | | | |
| | — Carlo Fort | 39 | 9 | 0 | 8 | 17 | 0 |
| | S. Antioco Island, | | | | | | |
| | — Point Sperone | 38 | 57 | 35 | 8 | 23 | 0 |
| | Toro Rock | 38 | 52 | 0 | 8 | 22 | 30 |
| | Cape Teulada | 38 | 51 | 36 | 8 | 36 | 42 |
| | Pula, Tower | 39 | 0 | 15 | 9 | 1 | 25 |
| | Cagliari, Mole | 39 | 12 | 10 | 9 | 6 | 36 |
| | Cape Carbonara, | | | | | | |
| | — Cavoli I., Tower | 39 | 4 | 24 | 9 | 32 | 0 |
| | Cape Bellavista | 39 | 59 | 30 | 9 | 45 | 0 |
| | Tavolara I., N. E. Pt. | 40 | 54 | 36 | 9 | 44 | 0 |
| | Montorio I., N.E. Pt. | 41 | 4 | 42 | 9 | 36 | 5 |
| | Madelaine I., N. Pt. | 41 | 16 | 0 | 9 | 25 | 0 |
| | Giraglia I., Tower | 43 | 1 | 42 | 9 | 23 | 53 |
| | Cape Corso | 43 | 0 | 35 | 9 | 22 | 55 |

| | (28) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| *Corsica.* | St Fiorenzo | 42 | 41 | 3 | 9 | 17 | 42 |
| | Calvi | 42 | 34 | 7 | 8 | 45 | 16 |
| | Cape Turghia, Tower | 42 | 14 | 11 | 8 | 32 | 49 |
| | Ajaccio | 41 | 55 | 1 | 8 | 44 | 4 |
| | Point Senetoso | 41 | 34 | 30 | 8 | 46 | 30 |
| | Bonifacio, Tower | 41 | 23 | 11 | 9 | 9 | 16 |
| | Porto Vecchio | 41 | 35 | 29 | 9 | 16 | 26 |
| | BASTIA, Church | 42 | 41 | 36 | 9 | 26 | 45 |
| *Italian Islands.* | Gorgona, Tower | 43 | 25 | 25 | 9 | 53 | 40 |
| | Capraja, N. Point, | 43 | 4 | 30 | 9 | 50 | 0 |
| | — South Point | 43 | 0 | 10 | 9 | 49 | 0 |
| | Elba, Cape Vita | 42 | 52 | 12 | 10 | 25 | 10 |
| | — Port Ferragio | 42 | 48 | 40 | 10 | 19 | 30 |
| | — Cape Infola | 42 | 50 | 12 | 10 | 15 | 20 |
| | — Cape Dorana | 42 | 48 | 15 | 10 | 5 | 30 |
| | — Cape Calamita | 42 | 42 | 2 | 10 | 24 | 28 |
| | Pianosa, N. Point | 42 | 35 | 10 | 10 | 7 | 0 |
| | Africa Rocks or West Formiches | 42 | 21 | 20 | 10 | 8 | 20 |
| | Monte Christo, mid. | 42 | 19 | 40 | 10 | 20 | 0 |
| | East Formiches | 42 | 37 | 0 | 10 | 53 | 0 |
| | Giglio Island, N. Pt. | 42 | 21 | 40 | 10 | 57 | 0 |
| | — South Point | 42 | 17 | 25 | 10 | 58 | 45 |
| | Gianuti, mid. | 42 | 13 | 10 | 11 | 9 | 0 |
| | Palmarola, N. Point | 40 | 57 | 8 | 12 | 52 | 10 |
| | Ponza, S. Point | 40 | 52 | 39 | 12 | 57 | 35 |
| | Botte Rock | 40 | 50 | 20 | 13 | 6 | 10 |
| | Zannoni, mid. | 40 | 57 | 40 | 13 | 3 | 30 |
| | Vandotina, N end | 40 | 47 | 30 | 13 | 25 | 40 |
| | Iachia, Castle | 40 | 43 | 50 | 13 | 57 | 5 |
| | — Point Imperator | 40 | 42 | 0 | 13 | 49 | 45 |
| | Procida, N. E. Point | 40 | 46 | 0 | 14 | 1 | 25 |
| | Capri, Point Carena | 40 | 30 | 45 | 14 | 11 | 40 |
| *Sicily.* | Faro, Light | 38 | 15 | 50 | 15 | 40 | 40 |
| | Messina, Light | 38 | 11 | 30 | 15 | 34 | 40 |
| | *Var. 18° 33′ W.* | | | | | | |
| | Scaletta, Fort | 38 | 1 | 45 | 15 | 27 | 45 |
| | Taormina | 37 | 48 | 15 | 15 | 17 | 40 |
| | Mount Etna, peak | 37 | 43 | 31 | 15 | 0 | 0 |
| | Aci Reale, Pt. Tocco | 37 | 34 | 20 | 15 | 11 | 30 |
| | Catania, Mole | 37 | 28 | 20 | 15 | 5 | 15 |
| | Augusta, Light | 37 | 12 | 50 | 15 | 13 | 15 |
| | Syracuse, Light | 37 | 2 | 58 | 15 | 16 | 50 |
| | Passaro Island, Tower | 36 | 41 | 30 | 15 | 8 | 56 |
| | Cape Passaro | 36 | 40 | 0 | 15 | 7 | 30 |
| | Cape Scalambra Tower | 36 | 46 | 13 | 14 | 30 | 15 |
| | Scoglietti | 36 | 52 | 34 | 14 | 27 | 25 |
| | Terranova | 37 | 2 | 54 | 14 | 15 | 0 |
| | Alicata, Castle | 37 | 4 | 3 | 13 | 55 | 54 |
| | Palma | 37 | 8 | 47 | 13 | 43 | 11 |
| | Girgenti, Mole | 37 | 15 | 39 | 13 | 31 | 40 |
| | Cape Bianco | 37 | 22 | 25 | 13 | 16 | 27 |
| | Cape St. Marco | 37 | 29 | 15 | 13 | 0 | 20 |
| | Cape Granitola | 37 | 33 | 57 | 12 | 36 | 39 |
| | Mazzara, Citadel | 37 | 39 | 56 | 12 | 33 | 59 |
| | Marsala, Cape Boco | 37 | 48 | 10 | 12 | 25 | 10 |
| | Trapani, Light | 38 | 1 | 53 | 12 | 30 | 18 |
| | Cape St. Vito, Church | 38 | 12 | 26 | 12 | 45 | 50 |
| | Castel a Mare, Fort | 38 | 1 | 51 | 12 | 52 | 43 |
| | Cape de Gallo | 38 | 14 | 50 | 13 | 18 | 30 |

## LATITUDES AND LONGITUDES.

| (29) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Sicily.* | | | | | | |
| PALERMO, Light | 38 | 8 | 15 | 13 | 21 | 56 |
| *Var.* 18° 45′ *W.* | | | | | | |
| — Observatory | 38 | 6 | 44 | 13 | 20 | 15 |
| Cape Zaffarana | 38 | 6 | 0 | 13 | 34 | 0 |
| Termini, Castle | 37 | 57 | 28 | 13 | 42 | 0 |
| Cefalu, Cathedral | 38 | 0 | 0 | 14 | 3 | 57 |
| Caronia | 37 | 59 | 45 | 14 | 26 | 0 |
| Cape Orlando | 38 | 7 | 46 | 14 | 44 | 30 |
| Cape Calava | 38 | 9 | 40 | 14 | 54 | 0 |
| Melazzo, Light | 38 | 15 | 58 | 15 | 14 | 10 |
| *Sicilian Islands.* | | | | | | |
| Eolian Islands, | | | | | | |
| — Stromboli, Church | 38 | 48 | 12 | 15 | 13 | 10 |
| — Basiluzza, Ruin | 38 | 39 | 50 | 15 | 7 | 54 |
| — Panaria, S. W. Pt. | 38 | 37 | 40 | 15 | 2 | 55 |
| — Penrose Rock | 38 | 38 | 0 | 14 | 54 | 30 |
| — Lipari, Castle | 38 | 27 | 56 | 14 | 57 | 50 |
| — Vulcano, Sul Wks. | 38 | 23 | 19 | 14 | 55 | 56 |
| — Salina, Amafi Ch. | 38 | 35 | 40 | 14 | 47 | 35 |
| — Felicudi, Church | 38 | 34 | 5 | 14 | 29 | 37 |
| — Alicudi, Church | 38 | 32 | 41 | 14 | 16 | 30 |
| — Ustica | 38 | 43 | 17 | 13 | 11 | 10 |
| *Var.* 17° 41′ *W.* | | | | | | |
| Ægadian Isles, | | | | | | |
| — Maritimo, Castle | 38 | 1 | 10 | 12 | 3 | 55 |
| — Levanso | 38 | 1 | 38 | 12 | 20 | 29 |
| — Favignana, Castle | 37 | 56 | 36 | 12 | 17 | 45 |
| Pentellaria, Fort | 36 | 51 | 15 | 11 | 54 | 29 |
| *Var.* 16° 22′ *W.* | | | | | | |
| Linosa | 35 | 51 | 50 | 12 | 52 | 9 |
| Lampedusa, Castle | 35 | 29 | 19 | 12 | 35 | 10 |
| Lampion | 35 | 33 | 10 | 12 | 19 | 10 |
| Goza, N. W. Point | 36 | 3 | 45 | 14 | 8 | 0 |
| Malta, Valetta Obs. | 35 | 53 | 55 | 14 | 30 | 50 |
| *Var.* 17° 21′ *W.* | | | | | | |
| — Point Benhisa | 35 | 49 | 0 | 14 | 33 | 0 |
| — Telfola Rock | 35 | 46 | 30 | 14 | 28 | 30 |
| Esquerque or Skirki Rocks, mid. | 37 | 46 | 0 | 10 | 47 | 0 |
| Keiths' Reef, mid. | 37 | 50 | 0 | 11 | 9 | 0 |
| Galita | 37 | 32 | 30 | 8 | 55 | 0 |
| Sorelli Rocks | 37 | 24 | 50 | 8 | 37 | 0 |
| *Islands in the Gulf of Venice.* | | | | | | |
| Unie, Church | 44 | 38 | 19 | 14 | 14 | 42 |
| Sansego, Mt. Garbe | 44 | 30 | 55 | 14 | 18 | 8 |
| Lossini, Piccolo Ch. | 44 | 32 | 1 | 14 | 27 | 57 |
| Pago, Mount S. Vito | 44 | 28 | 40 | 14 | 59 | 37 |
| Premuda, Signal Staff | 44 | 20 | 12 | 14 | 36 | 49 |
| Selve, Steeple | 44 | 22 | 31 | 14 | 41 | 53 |
| Ulbo, Mole | 44 | 22 | 54 | 14 | 46 | 58 |
| Scarda, Signal | 44 | 17 | 16 | 14 | 42 | 20 |
| Isto, Signal | 44 | 16 | 40 | 14 | 46 | 19 |
| Puntadura, Mt. S. Geo. | 44 | 18 | 10 | 15 | 3 | 13 |
| Melada, Steeple | 44 | 12 | 48 | 14 | 52 | 38 |
| Grossa or Lunga, | | | | | | |
| — Punta Bianchi | 44 | 9 | 0 | 14 | 49 | 36 |
| Peschiera Shoal | 43 | 45 | 36 | 15 | 20 | 37 |
| Curbavela, E. Point | 43 | 41 | 26 | 15 | 30 | 56 |
| Zuri, Mount Bol | 43 | 39 | 19 | 15 | 38 | 42 |
| Brazza, | | | | | | |
| — Milna, Steeple | 43 | 19 | 20 | 16 | 26 | 57 |
| — Mount S. Vito | 43 | 16 | 43 | 16 | 37 | 18 |

| (30) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Islands in the Gulf of Venice.* | | | | | | |
| Pomo Rock | 43 | 5 | 27 | 15 | 27 | 40 |
| St. Andrea | 43 | 1 | 40 | 15 | 45 | 30 |
| Busi, Signal | 42 | 57 | 42 | 16 | 1 | 3 |
| Lissa, Mount Hum | 43 | 1 | 43 | 16 | 6 | 54 |
| — Town | 43 | 3 | 10 | 16 | 11 | 30 |
| Lessina, | | | | | | |
| — Fort Imperial | 43 | 10 | 45 | 16 | 27 | 4 |
| — Mount S. Nicolo | 43 | 6 | 34 | 16 | 36 | 0 |
| — S. Georgio Tower | 43 | 7 | 29 | 17 | 11 | 29 |
| Curzola, | | | | | | |
| — Fort San Blas | 42 | 57 | 25 | 17 | 7 | 59 |
| — S. Giovanni di Bl. | 42 | 58 | 5 | 16 | 40 | 34 |
| Cazza, Signal | 42 | 46 | 2 | 16 | 30 | 54 |
| Lagosta, | | | | | | |
| — Mount S. Georgio | 42 | 45 | 1 | 16 | 51 | 45 |
| Lagostini Rks. E. end | 42 | 45 | 51 | 17 | 8 | 52 |
| Meleda, | | | | | | |
| — Port Pelazza | 42 | 47 | 6 | 17 | 22 | 50 |
| — Point Grui | 42 | 41 | 16 | 17 | 45 | 10 |
| Pelagosa, Signal | 42 | 23 | 44 | 16 | 16 | 3 |
| Cajola Rock | 42 | 23 | 0 | 16 | 22 | 0 |
| Pianosa, Signal | 42 | 13 | 40 | 15 | 45 | 23 |
| Tremiti, S. Nicola | 42 | 7 | 30 | 15 | 31 | 4 |
| *Ionian Islands.* | | | | | | |
| Fano, N. W. Point | 39 | 52 | 15 | 19 | 19 | 15 |
| Merlera, mid. | 39 | 53 | 15 | 19 | 31 | 40 |
| Samotraki, N. W. Pt. | 39 | 46 | 30 | 19 | 27 | 0 |
| Corfu, Cape Draste | 39 | 48 | 15 | 19 | 38 | 0 |
| — Tignosa, Light | 39 | 48 | 0 | 19 | 57 | 30 |
| — Citadel, Light | 39 | 37 | 0 | 19 | 56 | 0 |
| — Cape Bianco, Lt. | 39 | 21 | 0 | 20 | 7 | 0 |
| Paxo, Gayo Light | 39 | 11 | 30 | 20 | 12 | 20 |
| Anti Paxo, S. E. end | 39 | 8 | 30 | 20 | 15 | 45 |
| Leucadia or Santa Maura, | | | | | | |
| — Castle | 38 | 50 | 10 | 20 | 43 | 15 |
| — Sisola Rock | 38 | 42 | 0 | 20 | 32 | 30 |
| — Cape Ducato | 38 | 33 | 30 | 20 | 32 | 45 |
| — Pt. Lypso Prygo | 38 | 34 | 40 | 20 | 38 | 45 |
| Arkudi, S. Point | 38 | 32 | 15 | 20 | 43 | 0 |
| Meganisi, S. Point | 38 | 35 | 20 | 20 | 48 | 30 |
| Kelamo, S. Point | 38 | 34 | 45 | 20 | 52 | 30 |
| Kastus, S. Point | 38 | 32 | 30 | 20 | 54 | 45 |
| Atoke, N. Point | 38 | 30 | 15 | 20 | 48 | 30 |
| Cephalonia, | | | | | | |
| — Cape Viscardo | 38 | 28 | 40 | 20 | 33 | 0 |
| — Cape Aterra | 38 | 21 | 30 | 20 | 24 | 15 |
| — Cape Aji | 38 | 6 | 40 | 20 | 23 | 30 |
| — Port Argostoli | 38 | 10 | 40 | 20 | 29 | 15 |
| — Cape Skala | 38 | 3 | 0 | 20 | 46 | 30 |
| — Cape Capri | 38 | 7 | 0 | 20 | 49 | 30 |
| — Point Kelia | 38 | 16 | 30 | 20 | 41 | 30 |
| Ithaca or Theaki, | | | | | | |
| — Point Marmara | 38 | 30 | 0 | 20 | 39 | 0 |
| — Bathi, entr. | 38 | 23 | 0 | 20 | 42 | 30 |
| — Point Agiani | 38 | 19 | 20 | 20 | 46 | 0 |
| Oxia, S. end | 38 | 17 | 20 | 21 | 6 | 15 |
| Zante, Cape Skinari | 37 | 56 | 50 | 20 | 41 | 30 |
| — Cape Kieri | 37 | 38 | 35 | 20 | 49 | 30 |
| — Point Basilika | 37 | 44 | 0 | 21 | 0 | 40 |
| — Zante, Castle | 37 | 47 | 26 | 20 | 54 | 15 |
| — Point Krionera | 37 | 48 | 40 | 20 | 55 | 0 |

## LATITUDES AND LONGITUDES.

| (31) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Cretan Archipelago.* | | | | | | |
| Montague, N.W. Rock | 37 | 56 | 30 | 20 | 58 | 30 |
| Stamphanes, | | | | | | |
| — Convent Island | 37 | 18 | 0 | 21 | 1 | 30 |
| Cerigo, Cape Spati | 36 | 22 | 30 | 22 | 56 | 30 |
| Kapsali | 36 | 7 | 20 | 23 | 0 | 0 |
| — St. Nicolo | 36 | 13 | 0 | 23 | 5 | 30 |
| Ovo, middle | 36 | 4 | 45 | 23 | 0 | 30 |
| Porri | 35 | 56 | 0 | 23 | 15 | 15 |
| Cerigotto, S. Point | 35 | 49 | 15 | 23 | 18 | 0 |
| Cape Crio or St. John | 35 | 15 | 45 | 23 | 32 | 35 |
| Sordi Island | 35 | 34 | 20 | 23 | 27 | 3 |
| Grabusa Island | 35 | 38 | 0 | 23 | 33 | 35 |
| Cape Buso | 35 | 36 | 38 | 23 | 35 | 30 |
| Cape Spada | 35 | 40 | 30 | 23 | 44 | 5 |
| *Candia.* Canea, Town | 35 | 28 | 40 | 24 | 0 | 25 |
| Cape Maleka | 35 | 35 | 5 | 24 | 8 | 23 |
| Retymo, Town | 35 | 22 | 17 | 24 | 28 | 12 |
| Cape Retymo | 35 | 25 | 52 | 24 | 41 | 10 |
| CANDIA | 35 | 21 | 0 | 25 | 8 | 0 |
| Cape St. John | 35 | 19 | 10 | 25 | 46 | 45 |
| Cape Sidero | 35 | 17 | 40 | 26 | 18 | 40 |
| Cape Salimon | 35 | 9 | 15 | 26 | 19 | 25 |
| Cape Xacro or Yala | 35 | 2 | 0 | 26 | 15 | 25 |
| Christiana Islands | 34 | 54 | 0 | 26 | 8 | 15 |
| Gaidronisi Island | 34 | 52 | 35 | 25 | 43 | 15 |
| Cape Matala | 34 | 55 | 5 | 24 | 45 | 5 |
| Paxamides Islands | 34 | 59 | 40 | 24 | 34 | 50 |
| Gozzo Island, W. Pt. | 34 | 52 | 0 | 24 | 2 | 0 |
| Anti Gozzo | 34 | 56 | 15 | 23 | 59 | 25 |
| *Grecian Archipelago.* Caravi | 36 | 46 | 25 | 23 | 35 | 30 |
| Falconeri | 36 | 50 | 40 | 23 | 53 | 0 |
| Bello Poulo, N. Pt. | 36 | 57 | 15 | 23 | 26 | 35 |
| Spetzia, summit | 37 | 15 | 25 | 23 | 9 | 41 |
| Hydro, summit | 37 | 19 | 58 | 23 | 28 | 39 |
| — North East end | 37 | 23 | 0 | 23 | 35 | 0 |
| Poros, Mount Elias | 37 | 31 | 12 | 23 | 27 | 50 |
| Egina, Peak | 37 | 42 | 7 | 23 | 29 | 40 |
| St. George d'Arbora | 37 | 28 | 14 | 23 | 55 | 42 |
| Macronisi, N. end | 37 | 45 | 9 | 24 | 8 | 25 |
| — South end | 37 | 38 | 30 | 24 | 6 | 45 |
| Zea, Port entr. | 37 | 40 | 0 | 24 | 19 | 0 |
| — Mount | 37 | 37 | 18 | 24 | 21 | 40 |
| Thermia, summit | 37 | 26 | 14 | 24 | 23 | 30 |
| — South Point | 37 | 18 | 0 | 24 | 22 | 30 |
| Andro, Cape Guardia | 37 | 58 | 0 | 24 | 43 | 0 |
| — Summit | 37 | 50 | 8 | 24 | 50 | 22 |
| Tinos, S. Nichola Rd. | 37 | 33 | 0 | 25 | 8 | 0 |
| Miconi, N.W. Mount | 37 | 29 | 16 | 25 | 21 | 22 |
| Rhenea, middle | 37 | 25 | 0 | 25 | 15 | 0 |
| Ghioura, summit | 37 | 36 | 36 | 24 | 43 | 13 |
| Syra, summit | 37 | 28 | 56 | 24 | 55 | 28 |
| Pipero | 37 | 18 | 15 | 24 | 31 | 48 |
| Serpho, summit | 37 | 10 | 24 | 24 | 29 | 36 |
| Siphanto | 36 | 58 | 4 | 24 | 42 | 36 |
| Argentiero, summit | 36 | 49 | 20 | 24 | 33 | 23 |
| Polino, summit | 36 | 46 | 10 | 24 | 38 | 57 |
| Milo, Town | 36 | 41 | 42 | 24 | 29 | 36 |
| — Mount Elias | 36 | 40 | 27 | 24 | 23 | 14 |
| Anti Milo, summit | 36 | 47 | 42 | 24 | 14 | 33 |
| Policandro | 36 | 37 | 4 | 24 | 55 | 5 |

| (32) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Grecian Archipelago.* Skyeno, summit | 36 | 39 | 51 | 25 | 6 | 48 |
| Nio, summit | 36 | 42 | 44 | 25 | 20 | 50 |
| Heraclia, summit | 36 | 49 | 28 | 25 | 27 | 48 |
| Paros, Mount | 37 | 2 | 46 | 25 | 11 | 26 |
| — Nausa | 37 | 7 | 0 | 25 | 15 | 20 |
| Anti Paros | 36 | 59 | 40 | 25 | 3 | 27 |
| Naxia, Mount Dia | 37 | 1 | 51 | 25 | 31 | 4 |
| — Town | 37 | 6 | 0 | 25 | 22 | 0 |
| Karos, summit | 36 | 53 | 29 | 25 | 39 | 52 |
| Amorga, E. end | 36 | 53 | 30 | 26 | 6 | 0 |
| Amorga Poulo | 36 | 36 | 55 | 25 | 42 | 34 |
| Santorin, Mt. St. Elias | 36 | 21 | 56 | 25 | 28 | 33 |
| Christiana Islands | 36 | 14 | 41 | 25 | 18 | 45 |
| Anaphi or Nanphio | 36 | 22 | 21 | 25 | 47 | 9 |
| Hermonisi or Fidulee | 36 | 32 | 25 | 26 | 9 | 40 |
| Tragonisi or | | | | | | |
| Ponticusa, summit | 36 | 32 | 48 | 26 | 14 | 4 |
| Stanphalia, Mt Veglia | 36 | 32 | 10 | 26 | 19 | 35 |
| St. John or Cherni | 36 | 20 | 51 | 26 | 41 | 38 |
| Kaleori or Monks | 38 | 9 | 59 | 25 | 18 | 0 |
| Skyros, Mt. Cochila | 38 | 49 | 45 | 24 | 37 | 5 |
| — Grand Port, entr. | 38 | 47 | 30 | 24 | 31 | 0 |
| Scopelo or Scopoli, | | | | | | |
| — Mount Delphi | 39 | 8 | 13 | 23 | 41 | 50 |
| Skiathos, N. Point | 39 | 12 | 0 | 23 | 30 | 0 |
| Pelerissa, summit | 39 | 20 | 0 | 24 | 5 | 0 |
| Joura, summit | 39 | 23 | 40 | 24 | 11 | 0 |
| Piperi | 39 | 20 | 30 | 24 | 19 | 0 |
| St. Estrati, summit | 39 | 31 | 0 | 25 | 2 | 0 |
| Lemnos, N. W. Pt. | 39 | 59 | 0 | 25 | 2 | 30 |
| — Cape Stala, S. Pt. | 39 | 47 | 30 | 25 | 23 | 30 |
| — Pt. Blava, N.E. Pt. | 40 | 2 | 0 | 25 | 28 | 0 |
| Tenedos, Peak | 39 | 50 | 14 | 26 | 3 | 45 |
| Imbros, summit | 40 | 10 | 36 | 25 | 51 | 20 |
| Samothraki, summit | 40 | 26 | 57 | 25 | 35 | 54 |
| Thaso, summit | 40 | 42 | 2 | 24 | 42 | 45 |
| Mytelen, Cape Sigri | 39 | 15 | 0 | 25 | 52 | 0 |
| — Port Longoni, entr. | 39 | 5 | 0 | 26 | 5 | 0 |
| — Port Oliveir, entr. | 39 | 1 | 0 | 26 | 38 | 0 |
| — Town | 39 | 6 | 0 | 26 | 35 | 0 |
| Psara, Mount | 38 | 35 | 34 | 26 | 36 | 0 |
| Scio, Northern Mount | 38 | 33 | 42 | 26 | 0 | 55 |
| — Cape Mastico | 38 | 8 | 0 | 25 | 59 | 0 |
| — Town, Lights | 38 | 22 | 20 | 26 | 5 | 0 |
| Nicaria, S. W. Mount | 37 | 31 | 9 | 26 | 2 | 38 |
| Samos, W. Mount | 37 | 43 | 44 | 26 | 38 | 21 |
| — Port Vathi | 37 | 46 | 0 | 26 | 58 | 0 |
| Patino or Patmos, | | | | | | |
| — South Mount | 37 | 17 | 2 | 26 | 35 | 14 |
| Lero, Mount Chidi | 37 | 10 | 44 | 26 | 51 | 17 |
| Calymnos, summit | 36 | 59 | 30 | 26 | 59 | 0 |
| Cos or Stance, | | | | | | |
| — Mount Christo | 36 | 49 | 54 | 27 | 13 | 34 |
| — Town | 36 | 53 | 11 | 27 | 16 | 37 |
| Nissari, summit | 36 | 35 | 30 | 27 | 11 | 0 |
| Tilo or Piscopi, | | | | | | |
| — N. W. Mount | 36 | 26 | 22 | 27 | 20 | 48 |
| Karki | 36 | 13 | 0 | 27 | 35 | 0 |
| Caso, S. Point | 35 | 18 | 20 | 26 | 52 | 35 |
| Scarpanto, S. Point | 35 | 23 | 30 | 27 | 12 | 55 |
| — North Point | 35 | 50 | 30 | 27 | 11 | 25 |
| Scarpenton, N. Point | 35 | 54 | 20 | 27 | 12 | 25 |

## LATITUDES AND LONGITUDES.

| (33) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Rhodes, Mole | 36 | 26 | 53 | 28 | 12 | 51 |
| — St. Catharine's I. | 35 | 52 | 0 | 27 | 45 | 30 |
| — Cape St. John | 36 | 3 | 45 | 28 | 4 | 0 |
| Three Brothers | 35 | 50 | 20 | 27 | 55 | 10 |
| Cape Salizano | 35 | 6 | 20 | 32 | 16 | 30 |
| Cape Cormachiti | 35 | 23 | 50 | 32 | 57 | 5 |
| Cape St. Andrea | 35 | 41 | 40 | 34 | 37 | 25 |
| Famagousta | 35 | 7 | 40 | 33 | 59 | 5 |
| Cape Grego | 34 | 57 | 50 | 34 | 6 | 25 |
| Larnaca | 34 | 55 | 13 | 33 | 39 | 32 |
| Cape Chiti, Tower | 34 | 49 | 55 | 33 | 38 | 15 |
| Limasol | 34 | 41 | 15 | 33 | 3 | 45 |
| Cape Gatte | 34 | 32 | 50 | 33 | 1 | 35 |
| Cape Blanco | 34 | 39 | 20 | 32 | 40 | 15 |
| Baffa or Paphos | 34 | 47 | 20 | 32 | 26 | 20 |

*Cyprus.*

XIII. The Coast of AFRICA from the entrance to the MEDITERRANEAN to the CAPE OF GOOD HOPE.

| | | | | West | | |
|---|---|---|---|---|---|---|
| Cape Spartel | 35 | 47 | 15 | 5 | 54 | 25 |
| Larash | 35 | 10 | 0 | 6 | 9 | 0 |
| New Salee or Rabat | 34 | 5 | 0 | 6 | 43 | 0 |
| Azamor | 33 | 22 | 30 | 8 | 13 | 0 |
| Cape Blanco | 33 | 6 | 0 | 8 | 38 | 0 |
| Cape Cantin | 32 | 35 | 0 | 9 | 4 | 0 |
| Saffie | 32 | 20 | 0 | 8 | 56 | 0 |
| Mogadore Island | 31 | 25 | 0 | 9 | 32 | 0 |
| Cape Geer | 30 | 38 | 0 | 9 | 52 | 0 |
| Cleveland Shoal | 30 | 45 | 0 | 10 | 23 | 0 |
| Santa Cruz | 30 | 30 | 0 | 9 | 42 | 0 |
| Cape Non | 28 | 41 | 0 | 11 | 15 | 20 |
| River Non, entrance | 28 | 17 | 0 | 11 | 31 | 0 |
| False Cape Bojador | 26 | 25 | 12 | 14 | 12 | 30 |
| Cape Bojador | 26 | 7 | 10 | 14 | 31 | 30 |
| Seven Capes | 24 | 41 | 10 | 15 | 0 | 30 |
| River Ouro, Herne I. | 23 | 51 | 40 | 15 | 45 | 0 |
| Cape Barbas | 22 | 19 | 30 | 16 | 39 | 10 |
| Cape Blanco | 20 | 50 | 0 | 17 | 6 | 30 |
| Cape Mirik | 19 | 25 | 0 | 16 | 34 | 0 |
| Portendik | 18 | 20 | 0 | 16 | 2 | 0 |
| Barbara Point | 15 | 55 | 0 | 16 | 32 | 30 |
| SENEGAL, FortSt.Louis | 16 | 0 | 50 | 16 | 32 | 0 |
| Cape Verd, the Paps | 14 | 43 | 25 | 17 | 30 | 45 |
| — North West Pitch | 14 | 44 | 40 | 17 | 32 | 20 |
| Goree Island, Town | 14 | 39 | 50 | 17 | 25 | 0 |
| *Var.* 17° 31′ *W.* | | | | | | |
| R. Gambia, Bird I. | 13 | 39 | 10 | 16 | 40 | 30 |
| — Cape St. Mary | 13 | 30 | 10 | 16 | 41 | 20 |
| — Bathurst Town | 13 | 28 | 0 | 16 | 35 | 20 |
| *Var.* 17° 56′ *W.* | | | | | | |
| Cape Roxo | 12 | 23 | 0 | 16 | 51 | 15 |
| Bissao, Fort | 11 | 51 | 0 | 15 | 37 | 10 |
| *Var.* 18° 0′ *W.* | | | | | | |
| Bijooga Islands, | | | | | | |
| — Balama I., S. Pt. | 11 | 29 | 0 | 15 | 36 | 0 |
| — Tombelly, N. Pt. | 11 | 29 | 0 | 15 | 30 | 0 |
| — Galina I., W. Pt. | 11 | 27 | 40 | 15 | 46 | 30 |

*Morocco.* *Arab Coast.* *Senegambia.*

| (34) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Bijooga Islands, | | | | | | |
| — Orango I., S.E. Pt. | 11 | 3 | 10 | 15 | 55 | 10 |
| — West Point | 11 | 6 | 0 | 16 | 15 | 0 |
| Rio Grande Shoals, | | | | | | |
| — South Breakers | 10 | 42 | 20 | 16 | 18 | 10 |
| — West Breakers | 11 | 31 | 30 | 16 | 56 | 0 |
| Pullam Island | 10 | 51 | 42 | 15 | 45 | 5 |
| Alcatraz Island | 10 | 37 | 10 | 15 | 26 | 30 |
| Nunez River, entr. | 10 | 36 | 0 | 14 | 42 | 20 |
| Cape Verga | 10 | 19 | 0 | 14 | 23 | 30 |
| De Los Islands, | | | | | | |
| — Crawford Island | 9 | 27 | 30 | 13 | 48 | 30 |
| — Tamara I., N. Pt. | 9 | 31 | 0 | 13 | 40 | 30 |
| — Tamara I., S. Pt. | 9 | 26 | 30 | 13 | 51 | 24 |
| — Factory I., N. Pt. | 9 | 30 | 15 | 13 | 38 | 15 |
| Matacong Island | 9 | 14 | 0 | 13 | 25 | 30 |
| SIERRA LEONE, Cape | 8 | 30 | 0 | 13 | 18 | 30 |
| — Free Town | 8 | 29 | 42 | 13 | 14 | 20 |
| — King Tom's Point | 8 | 30 | 6 | 13 | 14 | 30 |
| — False Cape | 8 | 25 | 50 | 13 | 17 | 50 |
| *Var.* 18° 7′ *W.* | | | | | | |
| Cape Schilling | 8 | 9 | 30 | 13 | 10 | 10 |
| Banana Islands, Peak | 8 | 5 | 50 | 13 | 16 | 10 |
| Plantain Is., Gillmonis | 7 | 55 | 12 | 13 | 0 | 10 |
| Point Tassa | 7 | 55 | 30 | 13 | 2 | 10 |
| Sherbro Island, | | | | | | |
| — Cape St. Ann | 7 | 35 | 0 | 12 | 58 | 0 |
| Sherbro River, | | | | | | |
| — Turtle Is., N. end | 7 | 40 | 48 | 13 | 4 | 20 |
| — York Island | 7 | 32 | 0 | 12 | 26 | 40 |
| — Sea Bar, S. Point | 7 | 22 | 48 | 12 | 31 | 30 |
| Cape Mount | 6 | 44 | 40 | 11 | 25 | 0 |
| Cape Mesurada | 6 | 18 | 30 | 10 | 48 | 30 |
| Grand Bassa | 5 | 56 | 0 | 9 | 55 | 0 |
| Grand Sestros | 4 | 43 | 0 | 8 | 14 | 0 |
| Cape Palmas | 4 | 24 | 0 | 7 | 46 | 10 |
| *Var.* 19° *W.* | | | | | | |
| St. Andrew's River | 5 | 0 | 0 | 6 | 2 | 0 |
| Lahou, Town | 5 | 12 | 0 | 4 | 36 | 0 |
| Cape Appolonia | 4 | 44 | 0 | 2 | 33 | 0 |
| Axim | 4 | 47 | 42 | 2 | 17 | 30 |
| Cape Three Points | 4 | 45 | 0 | 2 | 4 | 15 |
| Dix Cove, Fort | 4 | 48 | 0 | 1 | 59 | 12 |
| Elmina Castle | 5 | 5 | 0 | 1 | 22 | 30 |
| Cape Coast Castle | 5 | 6 | 0 | 1 | 13 | 0 |
| Anamaboo | 5 | 10 | 12 | 1 | 7 | 10 |
| Cormantine Fort | 5 | 10 | 30 | 1 | 5 | 36 |
| Tantumquery Point | 5 | 12 | 30 | 0 | 46 | 48 |
| Barrakoo Point | 5 | 29 | 0 | 0 | 24 | 0 |
| Accra | 5 | 32 | 0 | 0 | 13 | 30 |
| | | | | East | | |
| Ningo Fort | 5 | 45 | 0 | 0 | 1 | 48 |
| Volta River, entr. | 5 | 47 | 18 | 0 | 42 | 18 |
| Cape St. Pauls | 5 | 45 | 0 | 0 | 52 | 18 |
| Quitta, Fort | 5 | 55 | 0 | 0 | 54 | 20 |
| Little Popo | 6 | 15 | 30 | 1 | 36 | 0 |
| Grand Popo | 6 | 19 | 0 | 1 | 46 | 0 |
| Whyda | 6 | 19 | 0 | 2 | 0 | 0 |
| Porto Novo | 6 | 23 | 0 | 2 | 21 | 0 |
| Badagry, Mount | 6 | 26 | 0 | 2 | 43 | 30 |
| Lagos River entr. | 6 | 26 | 0 | 3 | 22 | 0 |
| *Var.* 21° 6′ *W.* | | | | | | |

*Coast of Grenoa or Guinea.*



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## LATITUDES AND LONGITUDES.

| | (35) Places. | Lat. N. ° | ′ | ″ | Lon. E. ° | ′ | ″ |
|---|---|---|---|---|---|---|---|
| Benin. | Benin River, N. Pt. | 5 | 43 | 0 | 5 | 0 | 0 |
| | Ramos R., entr. | 5 | 5 | 30 | 5 | 23 | 18 |
| | Cape Formosa | 4 | 21 | 0 | 6 | 5 | 0 |
| | New Calebar R., W. Pt | 4 | 22 | 20 | 6 | 58 | 30 |
| | Old Calebar River, — Tom Shot's Point | 4 | 35 | 0 | 8 | 18 | 36 |
| Biafra. | Cameroon R., — South East Pt. | 3 | 49 | 12 | 9 | 32 | 24 |
| | Cape St. John | 1 | 10 | 0 | 9 | 18 | 40 |
| | Corisco Island | 0 | 54 | 30 | 9 | 17 | 30 |
| | Cape Esterias | 0 | 37 | 48 | 9 | 18 | 0 |
| | Gaboon R., Pt. Clara | 0 | 30 | 30 South | 9 | 17 | 30 |
| | Nazareth River | 0 | 37 | 12 | 8 | 57 | 50 |
| | Cape Lopez | 0 | 36 | 10 | 8 | 40 | 0 |
| | *Var.* 19° 8′ *W.* | | | | | | |
| Loango. | Cape St. Catharine | 1 | 51 | 0 | 9 | 11 | 0 |
| | Setteé River, entr. | 2 | 23 | 30 | 9 | 31 | 0 |
| | Point Pedros | 2 | 42 | 0 | 9 | 47 | 0 |
| | Mayumba Bay | 3 | 22 | 40 | 10 | 35 | 0 |
| | *Var.* 21° 4′ *W.* | | | | | | |
| | Loango River, entr. | 4 | 39 | 30 | 11 | 42 | 0 |
| Congo. | River Congo, — Cape Padron | 6 | 8 | 0 | 12 | 9 | 0 |
| | Ambriz Bay | 7 | 51 | 0 | 13 | 4 | 0 |
| | Dande Point | 8 | 28 | 0 | 13 | 14 | 0 |
| | St. Paul de Loando | 8 | 48 | 5 | 13 | 8 | 0 |
| | Cape Ledo | 9 | 46 | 0 | 13 | 12 | 0 |
| | Nova Redonda | 11 | 36 | 42 | 13 | 44 | 40 |
| | St. Philip de Benguela, — Fort | 12 | 34 | 0 | 13 | 20 | 0 |
| | Salinas | 12 | 53 | 0 | 12 | 53 | 12 |
| | Elephant Bay, Friars | 13 | 12 | 18 | 12 | 44 | 10 |
| | Cape Mary, Pillar | 13 | 25 | 12 | 12 | 31 | 50 |
| | Cape Martha | 13 | 54 | 10 | 12 | 23 | 30 |
| | *Var.* 22° *W.* | | | | | | |
| | Little Fish Bay, — Brown's Point | 15 | 13 | 0 | 12 | 2 | 0 |
| | Cape Negro | 15 | 40 | 42 | 11 | 53 | 20 |
| | Port Alexander | 15 | 47 | 0 | 11 | 46 | 30 |
| Western Coast of Africa. | Great Fish Bay, — Tiger Island, N. Pt. | 16 | 30 | 12 | 11 | 41 | 0 |
| | Cape Frio | 18 | 23 | 0 | 11 | 57 | 10 |
| | Cape Cross | 21 | 50 | 0 | 13 | 51 | 48 |
| | Walwich Bay, — Pelican Point | 22 | 52 | 30 | 14 | 22 | 5 |
| | Hollams Bird Island | 24 | 37 | 24 | 14 | 27 | 10 |
| | Angra Pequena | 26 | 38 | 30 | 15 | 2 | 30 |
| | Possession I., S. Pt. | 26 | 58 | 30 | 15 | 7 | 30 |
| | Orange River | 28 | 38 | 30 | 16 | 22 | 30 |
| | Cape Voltas | 28 | 44 | 0 | 16 | 26 | 30 |
| | *Var.* 29° *W.* | | | | | | |
| | Olephant River, entr. | 31 | 40 | 45 | 18 | 9 | 37 |
| | Cape Donkin | 31 | 54 | 12 | 18 | 14 | 10 |
| | Cape Deseada | 32 | 18 | 25 | 18 | 17 | 0 |
| | St. Helena Bay, — Paternoster Point | 32 | 42 | 12 | 17 | 49 | 10 |
| | Saldanha Bay, N. Pt. | 33 | 1 | 50 | 17 | 48 | 30 |
| | Point Isser | 33 | 9 | 18 | 18 | 5 | 40 |
| | Dassen Island | 33 | 26 | 12 | 18 | 1 | 30 |
| | Back Point | 33 | 33 | 48 | 18 | 14 | 0 |
| | Robben Island | 33 | 47 | 50 | 18 | 17 | 30 |

| | (36) Places. | Lat. S. ° | ′ | ″ | Lon. E. ° | ′ | ″ |
|---|---|---|---|---|---|---|---|
| Colony of Good Hope. | Table Bay, — Cape Town, Obs | 33 | 55 | 12 | 18 | 23 | 35 |
| | — Green Point, Light | 33 | 53 | 10 | 18 | 19 | 30 |
| | *Var.* 28° *W.* | | | | | | |
| | — Devils Peak | 33 | 57 | 12 | 18 | 21 | 30 |
| | Cape of Good Hope | 34 | 22 | 0 | 18 | 21 | 21 |
| | — Bellows Rock | 34 | 23 | 48 | 18 | 24 | 30 |
| | False Bay, — Simons Bay, D. Yd | 34 | 11 | 18 | 18 | 21 | 0 |
| | — Whittle Rock | 34 | 16 | 30 | 18 | 29 | 0 |
| | — Seal Islands | 34 | 8 | 48 | 18 | 30 | 10 |
| | — Anvil Rock | 34 | 22 | 40 | 18 | 26 | 5 |
| | False Cape or Hangklip | 34 | 23 | 45 | 18 | 45 | 0 |
| | *Var.* 28° 10′ *W.* | | | | | | |

## XIV. ISLANDS, ROCKS and SHOALS in the NORTH ATLANTIC OCEAN, and SOUTH ATLANTIC or SOUTHERN OCEAN.

| | | North ° | ′ | ″ | West ° | ′ | ″ |
|---|---|---|---|---|---|---|---|
| | Lion's Bank | 56 | 40 | 0 | 17 | 45 | 0 |
| | Rockal | 57 | 39 | 32 | 13 | 31 | 16 |
| | Aitkin's Rock? | 55 | 19 | 0 | 9 | 58 | 0 |
| | Brazil Rock | 51 | 10 | 0 | 16 | 0 | 0 |
| | Chapelle Bank? | 47 | 37 | 0 | 8 | 30 | 0 |
| | Devil's Rocks | 46 | 36 | 0 | 13 | 8 | 0 |
| | Negre's Rocks, about | 18 | 7 | 0 | 21 | 0 | 0 |
| | Isle Verte, abt. | 44 | 52 | 0 | 26 | 25 | 0 |
| | Greeve's Ledge, abt. | 44 | 15 | 0 | 25 | 5 | 0 |
| | Amplimont Rocks? | 42 | 30 | 0 | 24 | 5 | 0 |
| | Perseus' Shoal | 41 | 3 | 0 | 22 | 30 | 0 |
| | Hervagaults Breakers | 41 | 2 | 0 | 19 | 23 | 0 |
| | Three Chimneys? | 47 | 54 | 0 | 29 | 40 | 0 |
| | Gough's Rocks? | 40 | 28 | 0 | 33 | 0 | 0 |
| | Watson's Rock | 40 | 18 | 0 | 53 | 40 | 0 |
| | Whale Rock | 38 | 46 | 0 | 25 | 0 | 0 |
| | Eight Stones, N. Part? | 34 | 50 | 0 | 16 | 35 | 0 |
| | St. Mary's Bank, abt. | 35 | 53 | 0 | 27 | 19 | 0 |
| | Josyna Rock | 31 | 40 | 0 | 23 | 45 | 0 |
| | Tulloch's Rocks | 37 | 27 | 0 | 24 | 10 | 0 |
| | Breton's Rock, abt. | 39 | 40 | 0 | 41 | 35 | 0 |
| | Hume's Bank | 39 | 0 | 0 | 64 | 30 | 0 |
| | Rocks eastward of Bermudas? abt. | 32 | 20 | 0 | 57 | 30 | 0 |
| | Bermudas I., Town | 32 | 22 | 0 | 64 | 33 | 0 |
| | *Var.* 3° *W.* | | | | | | |
| | — Wreck Hill | 32 | 15 | 30 | 64 | 47 | 0 |
| | — North Rock | 32 | 29 | 0 | 64 | 39 | 30 |
| | Ashton Rock | 33 | 48 | 50 | 71 | 41 | 20 |
| | Mourand's Bank | 24 | 34 | 0 | 65 | 10 | 0 |
| | Inglefield Bank | 29 | 42 | 0 | 60 | 17 | 0 |
| Azores or Western Is. | Corvo, South Point | 39 | 41 | 13 | 31 | 3 | 0 |
| | Flores, Pt. Delgada | 39 | 33 | 29 | 31 | 8 | 30 |
| | *Var.* 18° 30′ *W.* | | | | | | |
| | Fayal, S E. point | 38 | 30 | 12 | 28 | 41 | 52 |
| | Pico, summit of Peak | 38 | 26 | 15 | 28 | 28 | 15 |
| | St. George, S. E. Pt. | 38 | 29 | 22 | 27 | 50 | 42 |
| | Graciosa, S. E. Pt. | 39 | 0 | 0 | 27 | 58 | 0 |
| | Terceira, Brazil Mt. | 38 | 38 | 33 | 27 | 12 | 48 |

## LATITUDES AND LONGITUDES.

| (37) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Madeira Islands.* | | | | | | |
| Terceira, Angra | 38 | 39 | 0 | 27 | 14 | 0 |
| St. Michael, | | | | | | |
| — Pt. Delgada, City | 37 | 45 | 10 | 25 | 41 | 30 |
| — Pt. Ferreria | 37 | 54 | 15 | 25 | 55 | 30 |
| *Var.* 25° 0′ *W.* | | | | | | |
| — Pt. de la Marquesa | 37 | 48 | 10 | 25 | 10 | 20 |
| Formigas, or Ants | 37 | 16 | 50 | 24 | 54 | 18 |
| St. Mary, Town | 36 | 58 | 0 | 25 | 12 | 33 |
| — S. W. Point | 36 | 57 | 31 | 25 | 14 | 18 |
| — S. E Point | 36 | 56 | 47 | 25 | 6 | 0 |
| Porto Santo, Town | 33 | 2 | 54 | 16 | 18 | 48 |
| *Var.* 23° 30′ *W.* | | | | | | |
| Madeira, E Point | 32 | 43 | 50 | 16 | 38 | 2 |
| — Funchal, Fort | 32 | 37 | 42 | 16 | 55 | 30 |
| *Var.* 21° *W.* | | | | | | |
| — West Point | 32 | 49 | 0 | 17 | 14 | 30 |
| — Brazen Head | 32 | 37 | 18 | 16 | 51 | 42 |
| Desertas, | | | | | | |
| — North I., N end | 32 | 36 | 30 | 16 | 33 | 0 |
| — South I., S. end | 32 | 28 | 30 | 16 | 31 | 18 |
| Salvages, Great | 30 | 7 | 54 | 15 | 54 | 40 |
| — Great Piton | 30 | 8 | 30 | 16 | 2 | 30 |
| *Canary Islands.* | | | | | | |
| Palma, N. Point | 28 | 52 | 30 | 17 | 56 | 30 |
| — Sta Cruz | 28 | 43 | 0 | 17 | 45 | 0 |
| — Tasacorta | 28 | 38 | 0 | 17 | 57 | 0 |
| Ferro, Valverde | 27 | 47 | 20 | 17 | 56 | 0 |
| — West Point | 27 | 44 | 0 | 18 | 9 | 0 |
| Gomera, Port | 28 | 5 | 40 | 17 | 7 | 0 |
| Teneriffe, | | | | | | |
| — Sta. Cruz, Mole | 28 | 28 | 0 | 16 | 15 | 0 |
| *Var.* 20° 0′ *W.* | | | | | | |
| — South Point | 28 | 1 | 0 | 16 | 42 | 0 |
| — Peak | 28 | 16 | 25 | 16 | 39 | 0 |
| — Orotava | 28 | 25 | 0 | 16 | 34 | 0 |
| Canary, | | | | | | |
| — Islets, or N.E. Pt. | 28 | 13 | 0 | 15 | 24 | 0 |
| — West Point | 28 | 1 | 20 | 15 | 50 | 0 |
| — South Point | 27 | 45 | 0 | 15 | 37 | 30 |
| Fuertaventura, | | | | | | |
| —Lobos Island | 28 | 45 | 0 | 13 | 49 | 0 |
| — S.W. Point | 28 | 4 | 0 | 14 | 28 | 50 |
| Lanzarota, | | | | | | |
| — South Point | 28 | 51 | 0 | 13 | 46 | 0 |
| — Port de Naos | 28 | 58 | 30 | 13 | 33 | 0 |
| — N. E. Point | 29 | 15 | 0 | 13 | 29 | 0 |
| Allegranza Island | 29 | 25 | 30 | 13 | 31 | 0 |
| *Cape Verde Islands.* | | | | | | |
| St. Antonio, N. Pt. | 17 | 12 | 0 | 25 | 9 | 20 |
| — East Point | 17 | 5 | 30 | 25 | 2 | 40 |
| — West Point | 17 | 4 | 0 | 25 | 25 | 45 |
| — Tarafal Bay | 16 | 56 | 48 | 25 | 22 | 30 |
| *Var.* 15° *W.* | | | | | | |
| — South Point | 16 | 55 | 0 | 25 | 22 | 0 |
| St. Vincent, | | | | | | |
| — Porto Grande | 16 | 54 | 0 | 25 | 4 | 0 |
| St. Lucea, N. Point | 16 | 49 | 0 | 24 | 50 | 30 |
| — East Point | 16 | 46 | 0 | 24 | 45 | 0 |
| Branca, center | 16 | 40 | 0 | 24 | 44 | 0 |
| Raza, E. Point | 16 | 38 | 0 | 24 | 38 | 30 |
| St. Nicholas, N. Pt. | 16 | 42 | 0 | 24 | 24 | 20 |

| (38) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Cape Verde Islands.* | | | | | | |
| St. Nicholas, W. Pt. | 16 | 38 | 0 | 24 | 30 | 0 |
| — Monte Gorda | 16 | 37 | 50 | 24 | 23 | 50 |
| — East Point | 16 | 34 | 30 | 24 | 3 | 0 |
| — South Point | 16 | 28 | 30 | 24 | 22 | 0 |
| Sal or Salt I., N. Pt. | 16 | 51 | 20 | 22 | 58 | 30 |
| — Mordeira Bay | 16 | 41 | 30 | 23 | 3 | 0 |
| *Var.* 14° 10′ *W.* | | | | | | |
| — South Point | 16 | 34 | 15 | 23 | 0 | 0 |
| Bonavista, N. W. Pt. | 16 | 13 | 20 | 22 | 59 | 40 |
| — North East Point | 16 | 11 | 0 | 22 | 46 | 30 |
| — New Town | 16 | 7 | 0 | 22 | 59 | 30 |
| — South Point | 15 | 57 | 0 | 22 | 52 | 40 |
| Leton Rocks | 15 | 48 | 0 | 23 | 13 | 0 |
| Mayo, N. Point | 15 | 19 | 0 | 23 | 16 | 0 |
| — English Road | 15 | 7 | 30 | 23 | 17 | 0 |
| — South Point | 15 | 6 | 40 | 23 | 14 | 0 |
| St. Jago, N. Point | 15 | 19 | 30 | 23 | 49 | 30 |
| — East Point | 15 | 0 | 30 | 23 | 29 | 0 |
| — Porto Praya | 14 | 53 | 40 | 23 | 34 | 0 |
| — S.W. Point | 14 | 58 | 30 | 23 | 47 | 0 |
| Fogo, N. Point | 15 | 1 | 15 | 24 | 25 | 0 |
| — Luz Town | 14 | 53 | 0 | 24 | 34 | 0 |
| — Peak | 14 | 56 | 0 | 24 | 23 | 40 |
| Brava, Road | 14 | 48 | 0 | 24 | 47 | 30 |
| *Islands in the South Atlantic.* | | | | | | |
| Warley's Shoal, abt. | 5 | 4 | 0 | 21 | 25 | 0 |
| French Shoal | 4 | 5 | 0 | 20 | 35 | 0 |
| Penedo de St. Pedro, or St. Paul's Rocks | 0 | 55 | 0 | 29 | 15 | 0 |
| Fernando Po, | | | | | East | |
| — Cape Bullen | 3 | 47 | 15 | 8 | 39 | 24 |
| — Point William | 3 | 45 | 36 | 8 | 45 | 0 |
| — Cape Horatio | 3 | 46 | 9 | 8 | 54 | 24 |
| — Cape Vidal | 3 | 39 | 18 | 8 | 56 | 20 |
| — Cape Barrow | 3 | 11 | 30 | 8 | 40 | 0 |
| *Var.* 24° 0′ *W.* | | | | | | |
| — Cape Eden | 3 | 15 | 30 | 8 | 25 | 5 |
| — Cape Badgley | 3 | 19 | 42 | 8 | 24 | 40 |
| — Charles' Folly | 3 | 26 | 48 | 8 | 27 | 40 |
| — Goat Island, center | 3 | 31 | 0 | 8 | 32 | 48 |
| Prince's Island, | | | | | | |
| — Fort St Antonio | 1 | 38 | 0 | 7 | 27 | 23 |
| — The Brothers | 1 | 23 | 0 | 7 | 19 | 48 |
| St. Thomas's Island, | | | | | | |
| — Man of War Bay | 0 | 27 | 0 | 6 | 44 | 42 |
| | | South | | | | |
| Annabona, Road | 1 | 25 | 0 | 5 | 42 | 48 |
| | | | | | West | |
| Bouvet's Sandy I., abt. | 0 | 28 | 0 | 19 | 10 | 0 |
| Triton's Bank | 0 | 32 | 0 | 17 | 46 | 0 |
| Fernando de Noronha, | | | | | | |
| — The Pyramid | 3 | 56 | 20 | 32 | 28 | 50 |
| Roccas | 3 | 52 | 12 | 33 | 20 | 0 |
| Blaesdale's Reef, abt. | 0 | 57 | 0 | 41 | 22 | 0 |
| Manoel Luis Rocks | 0 | 51 | 25 | 44 | 14 | 45 |
| *Var.* 0° 57′ *E.* | | | | | | |
| Sylva's Rocks | 0 | 32 | 0 | 44 | 17 | 20 |
| Trinidad, S. E. Point | 20 | 31 | 0 | 29 | 19 | 0 |
| *Var.* 5° *W.* | | | | | | |
| Martin Vas Rocks | 20 | 29 | 24 | 28 | 51 | 24 |
| Laurel's Shoal | 36 | 28 | 0 | 51 | 30 | 0 |
| Ascension I., Flagstaff | 7 | 55 | 56 | 14 | 23 | 50 |

# TABLE LVI.

## LATITUDES AND LONGITUDES.

| (39) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Islands in the South Atlantic.* | | | | | | |
| St. Helena, | | | | | | |
| — James Town | 15 | 54 | 48 | 5 | 45 | 20 |
| *Var.* 17° 30′ *W.* | | | | | | |
| Tristan da Cunha | 37 | 6 | 1 | 12 | 6 | 50 |
| Inaccessable I. | 37 | 19 | 0 | 12 | 13 | 0 |
| Nightingale I. | 37 | 29 | 0 | 12 | 11 | 0 |
| Gough's Island | 40 | 19 | 30 | 9 | 49 | 0 |
| Lennon's Reef, abt. | 37 | 31 | 0 | 4 | 42 | 0 |
| | | | | East | | |
| Whale Rock | 37 | 35 | 0 | 7 | 30 | 0 |
| Circumcision Land | 54 | 16 | 0 | 6 | 14 | 0 |
| Malouines or Falkland Islands, | | | | West | | |
| — Port Egmont | 51 | 24 | 0 | 59 | 56 | 0 |
| — Cape Percival | 51 | 43 | 0 | 61 | 29 | 0 |
| — Cape Meredith | 52 | 29 | 0 | 60 | 22 | 0 |
| — Solidad or Old Fort St. Louis | 51 | 32 | 0 | 58 | 4 | 15 |
| Beauchene Island | 52 | 56 | 30 | 59 | 12 | 0 |
| *Var.* 20° 45′ *E.* | | | | | | |
| Resignation I.? | 50 | 26 | 0 | 42 | 0 | 0 |
| Aurora Islands? | | | | | | |
| — Northernmost | 52 | 37 | 24 | 47 | 43 | 15 |
| — Middle Island | 53 | 2 | 40 | 47 | 55 | 15 |
| — Southernmost | 53 | 15 | 22 | 47 | 57 | 15 |
| Shag Rocks | 53 | 40 | 0 | 43 | 8 | 0 |
| *South Georgia.* | | | | | | |
| Wallis Island | 54 | 0 | 0 | 38 | 29 | 40 |
| Cape North | 54 | 4 | 45 | 38 | 15 | 0 |
| *Var.* 11° 15′ *E.* | | | | | | |
| Cape George | 54 | 17 | 0 | 36 | 32 | 30 |
| Sandwich Bay | 54 | 42 | 0 | 36 | 12 | 0 |
| Q. Charlotte's Cape | 54 | 32 | 0 | 36 | 11 | 30 |
| Coopers Island | 54 | 57 | 0 | 36 | 4 | 20 |
| C. Disappointment | 54 | 58 | 0 | 36 | 15 | 0 |
| Pickersgill Island | 54 | 42 | 30 | 36 | 58 | 0 |
| Clerk's Islands | 55 | 5 | 30 | 34 | 42 | 0 |
| *Sandwich Land.* | | | | | | |
| Candlemas Islands | 57 | 10 | 0 | 27 | 13 | 0 |
| Saunders Island | 58 | 0 | 0 | 26 | 58 | 0 |
| Cape Montague | 58 | 33 | 0 | 26 | 46 | 0 |
| Cape Bristol | 59 | 2 | 30 | 26 | 51 | 0 |
| Friesland Peak | 59 | 2 | 0 | 26 | 55 | 30 |
| Southern Thule | 59 | 34 | 0 | 27 | 45 | 0 |
| *South Shetland Islands.* | | | | | | |
| South Orkney's, or Powell's Groupe, | | | | | | |
| — Cape Dundas | 60 | 46 | 30 | 44 | 35 | 45 |
| — Saddle Island | 60 | 37 | 50 | 44 | 52 | 45 |
| — West Cape | 60 | 42 | 0 | 46 | 22 | 52 |
| *Var.* 16° 1′ *E.* | | | | | | |
| Clarence Island, | | | | | | |
| — Lloyd's Point | 61 | 7 | 0 | 54 | 23 | 0 |
| — Cape Bowles | 61 | 18 | 0 | 54 | 25 | 0 |
| Cornwallis Island | 61 | 2 | 0 | 54 | 41 | 0 |
| Elephant or Barrow's I. | | | | | | |
| — Cape Valentine | 61 | 5 | 0 | 54 | 55 | 0 |
| Seal Rocks | 61 | 1 | 0 | 55 | 32 | 0 |
| O'Brien's Islands | 62 | 32 | 0 | 56 | 20 | 0 |
| *Var.* 27° 30′ *E.* | | | | | | |
| Bridgman's I. | 62 | 4 | 0 | 56 | 57 | 30 |

| (40) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *South Shetland Islands.* | | | | | | |
| Cape Melville | 62 | 1 | 0 | 57 | 45 | 45 |
| North Foreland | 61 | 51 | 0 | 58 | 0 | 0 |
| Desolation Island | 62 | 24 | 0 | 60 | 25 | 0 |
| Cape Sheriff | 62 | 26 | 0 | 60 | 40 | 0 |
| *Var.* 28° *E.* | | | | | | |
| Start Point | 62 | 41 | 30 | 61 | 16 | 30 |
| Basil Hall's I. center | 62 | 47 | 30 | 61 | 40 | 0 |
| James' I., East end | 62 | 52 | 45 | 62 | 26 | 30 |
| — West end | 62 | 49 | 30 | 62 | 55 | 0 |
| Jameson's I., center | 63 | 4 | 0 | 62 | 17 | 30 |
| Deception I. East end | 63 | 2 | 0 | 60 | 45 | 0 |
| St. George's Bay | 62 | 6 | 0 | 58 | 6 | 0 |
| Hope Island | 63 | 5 | 30 | 56 | 44 | 0 |
| Alexander the First's I. | 69 | 30 | 0 | 75 | 0 | 0 |
| Peter the First's I. | 69 | 25 | 0 | 90 | 0 | 0 |

### XV. The Coast and adjacent Islands from the CAPE OF GOOD HOPE to CANTON.

| | South | | | East | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Colony of Good Hope.* | | | | | | |
| Cape of Good Hope | 34 | 22 | 0 | 18 | 24 | 24 |
| False Cape or Hangklip | 34 | 23 | 48 | 18 | 45 | 0 |
| *Var.* 28° 10′ *W.* | | | | | | |
| Mudge Point | 34 | 27 | 12 | 19 | 8 | 30 |
| Danger Point | 34 | 41 | 30 | 19 | 16 | 30 |
| Dyer's Island | 34 | 43 | 42 | 19 | 23 | 10 |
| Quoin Point | 34 | 48 | 48 | 19 | 36 | 40 |
| Cape Lagullas | 34 | 51 | 12 | 19 | 56 | 30 |
| Struy's Point | 34 | 42 | 24 | 20 | 11 | 0 |
| Cape Infanta | 34 | 30 | 50 | 20 | 48 | 0 |
| Leven Point | 34 | 27 | 20 | 21 | 20 | 0 |
| Cape Vaches | 34 | 19 | 42 | 21 | 51 | 24 |
| Flesh Point | 34 | 15 | 0 | 21 | 58 | 0 |
| Mozelle Bay, | | | | | | |
| — Cape St. Blaize | 34 | 7 | 0 | 22 | 6 | 40 |
| Knysna River, E. Pt. | 34 | 6 | 30 | 23 | 2 | 40 |
| Plettenburg Bay, | | | | | | |
| — Cape Seal | 34 | 4 | 48 | 23 | 17 | 30 |
| Cape St. Francis | 34 | 10 | 0 | 24 | 47 | 30 |
| Algoa Bay, | | | | | | |
| — Cape Recif | 34 | 2 | 10 | 25 | 36 | 10 |
| — St. Croix I., Peak | 33 | 47 | 36 | 25 | 41 | 30 |
| — Doddington Rock | 33 | 57 | 18 | 26 | 6 | 20 |
| — Bird Is., eastern | 33 | 52 | 5 | 26 | 12 | 50 |
| — Woody Cape | 33 | 46 | 30 | 26 | 9 | 0 |
| Point Padrone | 33 | 46 | 30 | 26 | 19 | 30 |
| Kowie R., entr. | 33 | 33 | 42 | 26 | 45 | 0 |
| Great Fish Point | 33 | 30 | 10 | 27 | 2 | 10 |
| Great Fish R., entr. | 33 | 27 | 0 | 27 | 2 | 30 |
| Keiskama R. entr. | 33 | 16 | 42 | 27 | 26 | 30 |
| Point Hood | 33 | 3 | 50 | 27 | 52 | 50 |
| Buffaloe River, | | | | | | |
| — Cape Morgan | 32 | 42 | 6 | 28 | 19 | 40 |
| *Var.* 30° *W.* | | | | | | |
| Hole in the Wall | 32 | 3 | 12 | 28 | 56 | 0 |
| St. John's River, entr | 31 | 34 | 30 | 29 | 23 | 40 |
| Cape Natal | 29 | 53 | 0 | 30 | 57 | 10 |
| Fisher's River, entr. | 29 | 16 | 18 | 31 | 28 | 0 |

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# TABLE LVI.

## LATITUDES AND LONGITUDES.

*The Eastern Coast of Africa.*

| (41) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Point Durnford | 29 | 0 | 12 | 31 | 46 | 30 |
| Cape St. Lucia | 28 | 32 | 30 | 32 | 22 | 30 |
| Cape Vidal | 28 | 9 | 36 | 32 | 33 | 0 |
| Delagoa Bay, | | | | | | |
| — Cape Collatto | 26 | 4 | 0 | 32 | 55 | 50 |
| — Inyack | 25 | 58 | 0 | 32 | 57 | 30 |
| — Elephant I., N. Pt. | 25 | 58 | 12 | 32 | 52 | 15 |
| — English R. Flagstaff | 25 | 58 | 12 | 32 | 31 | 42 |
| Lagoa River entr. | 25 | 20 | 36 | 33 | 8 | 0 |
| Inhampura R. entr. | 25 | 11 | 36 | 33 | 26 | 30 |
| Cape Corrientes | 24 | 7 | 30 | 35 | 25 | 25 |
| Inhamban Bay, Town | 23 | 51 | 42 | 35 | 19 | 40 |
| — Mafouroon I. | 23 | 44 | 30 | 35 | 22 | 30 |
| Cape Lady Gray | 22 | 56 | 12 | 35 | 36 | 0 |
| Bazarouta Is., N. Pt. | 21 | 31 | 0 | 35 | 28 | 0 |
| Inverarity's Shoal | 20 | 42 | 30 | 35 | 5 | 10 |
| Chuluwan I., N. Pt. | 20 | 38 | 12 | 34 | 48 | 30 |
| Sofala, Fort | 20 | 10 | 42 | 34 | 40 | 55 |
| Luabo Shoals | 18 | 57 | 40 | 35 | 55 | 0 |
| Quillimane R., Town | 17 | 51 | 48 | 36 | 56 | 0 |
| — Port Taugalane | 18 | 1 | 24 | 36 | 56 | 20 |
| — Senna, Town | 17 | 30 | 0 | 35 | 38 | 48 |
| David's Shoals | 17 | 31 | 30 | 38 | 27 | 12 |
| De Sylva Bank | 17 | 18 | 0 | 38 | 46 | 20 |
| Foga or Fire I. | 17 | 14 | 24 | 38 | 50 | 18 |
| Rasa Island | 17 | 6 | 30 | 39 | 1 | 20 |
| Trees Island | 17 | 4 | 18 | 39 | 4 | 50 |
| Macalonga Point | 16 | 58 | 48 | 39 | 1 | 10 |
| Caldeira Island | 16 | 38 | 48 | 39 | 40 | 48 |
| Angosha Is., Hurd's I | 16 | 33 | 24 | 39 | 44 | 50 |
| Mafamalor Mafamedel | 16 | 20 | 30 | 39 | 58 | 48 |
| Huddart's Shoals | 15 | 46 | 42 | 40 | 22 | 50 |
| Mogincale Shoals, | | | | | | |
| — North end | 15 | 33 | 36 | 40 | 29 | 30 |
| — South end | 15 | 36 | 0 | 40 | 27 | 30 |
| Barracouta Point | 15 | 30 | 0 | 40 | 31 | 0 |
| Mozambique, Fort | 15 | 1 | 0 | 40 | 41 | 48 |
| — St. George's I. | 15 | 2 | 12 | 40 | 43 | 30 |
| Quintangonya, S. Pt. | 14 | 52 | 30 | 40 | 45 | 35 |
| Melamo Point | 14 | 25 | 0 | 40 | 45 | 48 |
| Penda Shoal, E. end | 14 | 15 | 0 | 40 | 45 | 30 |
| Laguno Point | 14 | 12 | 30 | 40 | 39 | 48 |
| Soreessa Point | 13 | 32 | 48 | 40 | 31 | 55 |
| Badgley Point | 13 | 22 | 48 | 40 | 31 | 0 |
| Maunhanéor Devil's Pt | 12 | 56 | 30 | 40 | 32 | 40 |
| Pomba, N. Point | 12 | 55 | 48 | 40 | 28 | 0 |
| *Var.* 14° 30′ *W.* | | | | | | |
| Areemba Point | 12 | 38 | 12 | 40 | 34 | 30 |
| Querimba Islands, | | | | | | |
| — Foomo I., N. Pt. | 12 | 31 | 0 | 40 | 34 | 0 |
| — Querimba I., N. Pt. | 12 | 23 | 42 | 40 | 33 | 48 |
| — Ibo I., Fort | 12 | 20 | 0 | 40 | 33 | 0 |
| — Matemo I., E. Pt. | 12 | 13 | 48 | 40 | 34 | 50 |
| Pangané Point | 11 | 59 | 30 | 40 | 29 | 50 |
| Isla dos Mattos | 11 | 48 | 42 | 40 | 33 | 10 |
| Zanga Island | 11 | 37 | 42 | 40 | 30 | 30 |
| Vumba I., E. Pt. | 11 | 9 | 20 | 40 | 38 | 10 |
| Nondo Pt. | 11 | 0 | 30 | 40 | 30 | 0 |
| Tikomadjy I., N.E. Pt. | 10 | 46 | 0 | 40 | 35 | 40 |
| Cape Delgado | 10 | 41 | 12 | 40 | 34 | 36 |
| Roohamba Pt. | 10 | 13 | 30 | 40 | 9 | 0 |
| Monghou R., E. Pt. | 10 | 7 | 42 | 39 | 56 | 50 |

*The Eastern Coast of Africa.*

| (42) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Lindy R., Fort | 9 | 59 | 30 | 39 | 40 | 0 |
| Masonga River | 9 | 45 | 0 | 39 | 41 | 50 |
| Kisoohara R., N. Pt. | 9 | 26 | 0 | 39 | 33 | 40 |
| Keelwa, or Quiloa, | | | | | | |
| —Pagoda Point | 9 | 1 | 42 | 39 | 32 | 10 |
| Quiloa I. Fort | 8 | 57 | 0 | 39 | 29 | 0 |
| Songa Songa | 8 | 22 | 24 | 39 | 30 | 10 |
| Monfeea, W. Point | 7 | 56 | 0 | 39 | 33 | 40 |
| — Moresby Point | 7 | 38 | 36 | 39 | 52 | 42 |
| Poana Point | 7 | 2 | 42 | 39 | 32 | 12 |
| Latkanis I. | 6 | 54 | 12 | 39 | 55 | 30 |
| Zanzibar I., S. Point | 6 | 27 | 40 | 39 | 27 | 50 |
| — Town | 6 | 9 | 36 | 39 | 9 | 24 |
| — North Point | 5 | 42 | 48 | 39 | 15 | 30 |
| Paugany R. | | | | | | |
| — Maseewy I. | 5 | 30 | 0 | 39 | 4 | 0 |
| Pemba I., S. Point | 5 | 29 | 18 | 39 | 37 | 0 |
| Mesal Island, | | | | | | |
| — Chak Chak Bay | 5 | 15 | 40 | 39 | 35 | 20 |
| — N. W. Point | 4 | 52 | 0 | 39 | 38 | 42 |
| Mombas I., Fort | 4 | 4 | 0 | 39 | 38 | 0 |
| Killeely River, entr. | 3 | 37 | 48 | 39 | 47 | 50 |
| Maleenda | 3 | 12 | 48 | 40 | 6 | 10 |
| Formosa Bay, | | | | | | |
| — Ras Gomany | 3 | 0 | 0 | 40 | 13 | 30 |
| — Ozy River | 2 | 33 | 12 | 40 | 30 | 10 |
| Lamoo, Town | 2 | 15 | 42 | 40 | 51 | 10 |
| Ras Kattow | 2 | 18 | 42 | 40 | 52 | 30 |
| Patta, Town | 2 | 9 | 12 | 40 | 57 | 10 |
| Kisingatty | 2 | 6 | 12 | 41 | 7 | 10 |
| Dundas Is., Peak | 2 | 0 | 0 | 41 | 13 | 0 |
| — Simmanbaya | 1 | 45 | 30 | 41 | 26 | 40 |
| — Port Durnford, N Pt. | 1 | 13 | 12 | 41 | 49 | 10 |
| — Toola I. | 1 | 0 | 0 | 41 | 58 | 12 |
| — Thooala I., N. Pt. | 0 | 50 | 30 | 42 | 7 | 0 |
| — Kismayoo, N. Pt. | 0 | 36 | 48 | 42 | 16 | 50 |
| Dedalus Shoals | 0 | 24 | 24 | 42 | 38 | 40 |
| Juba R. entr. | 0 | 14 | 30 | 42 | 34 | 10 |
| | | | | North | | |
| Brava, Town | 1 | 6 | 48 | 43 | 58 | 15 |
| Torra | 1 | 26 | 0 | 44 | 16 | 0 |
| Marka | 1 | 44 | 10 | 44 | 46 | 50 |
| Horesly | 1 | 50 | 10 | 44 | 55 | 30 |
| Gezerat | 1 | 53 | 48 | 45 | 2 | 0 |
| Mukdeesha or | | | | | | |
| Magadosha | 2 | 1 | 48 | 45 | 19 | 30 |
| *Var.* 9° 0′ *W.* | | | | | | |
| Murot Hill | 2 | 41 | 15 | 46 | 12 | 0 |
| Ras Asoood | 4 | 34 | 10 | 47 | 55 | 30 |
| Ras Awath | 5 | 32 | 48 | 48 | 35 | 0 |
| Ras Ul Khyle | 7 | 43 | 30 | 49 | 40 | 30 |
| Ras Mabbere | 9 | 29 | 0 | 50 | 45 | 0 |
| Ras Hafoon or Orfui | 10 | 27 | 48 | 51 | 16 | 40 |
| Hor Hardeea | 10 | 34 | 30 | 50 | 56 | 0 |
| Ras Banna | 11 | 12 | 24 | 51 | 6 | 0 |
| Cape Guardafui | 11 | 41 | 4 | 51 | 12 | 24 |
| Ras Asser | 11 | 48 | 50 | 51 | 14 | 30 |
| Ras Met | 11 | 55 | 10 | 50 | 51 | 35 |
| Mette Island | 11 | 22 | 0 | 48 | 45 | 0 |
| Burnt Island | 11 | 17 | 0 | 47 | 21 | 0 |
| Burburra | 10 | 25 | 30 | 45 | 9 | 0 |
| Zeyla | 11 | 15 | 0 | 42 | 54 | 0 |

## LATITUDES AND LONGITUDES.

| (43) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *The Red Sea or Gulf of Arabia.* | | | | | | |
| Cape Rasbir | 12 | 12 | 0 | 43 | 25 | 0 |
| Abdul Koory I. W.Pt. | 12 | 12 | 35 | 52 | 2 | 50 |
| — N. E. Pt. | 12 | 11 | 30 | 52 | 18 | 0 |
| Salte's White Rocks | 12 | 25 | 30 | 52 | 4 | 10 |
| Brothers, Durjy I. | 12 | 6 | 0 | 53 | 2 | 50 |
| — Samsong I. | 12 | 10 | 50 | 52 | 51 | 0 |
| Karkafahroon Rks. | 12 | 39 | 50 | 52 | 57 | 0 |
| Socotra Island. | | | | | | |
| — Ras Rarby, W.Pt. | 12 | 30 | 0 | 53 | 3 | 30 |
| — Galanscea Road | 12 | 43 | 0 | 53 | 18 | 10 |
| — Pyramid Rock | 12 | 44 | 20 | 53 | 22 | 0 |
| — Tamarin | 12 | 36 | 40 | 53 | 41 | 0 |
| — RasShoorguy, E.Pt | 12 | 31 | 10 | 54 | 27 | 10 |
| Babelmandel I. | 12 | 38 | 0 | 43 | 29 | 0 |
| Babelmandel Cape | 12 | 40 | 0 | 43 | 31 | 0 |
| *Var.* 8° 45′ *W.* | | | | | | |
| Ras Rattah | 14 | 56 | 0 | 40 | 52 | 0 |
| Dhalak Island | 15 | 32 | 30 | 40 | 15 | 0 |
| Massowa Bay | 15 | 34 | 0 | 39 | 37 | 0 |
| Port Mornington | 18 | 16 | 0 | 38 | 32 | 0 |
| Suakin | 19 | 5 | 0 | 37 | 33 | 0 |
| Salaka | 20 | 28 | 0 | 37 | 27 | 0 |
| Cape Calmes | 21 | 28 | 0 | 37 | 25 | 0 |
| Cape Ras el ans | 23 | 56 | 0 | 35 | 48 | 0 |
| St. John's Island | 23 | 38 | 0 | 36 | 10 | 0 |
| Reef of Breakers | 24 | 4 | 0 | 36 | 16 | 0 |
| Dedalus Shoal | 24 | 58 | 0 | 35 | 56 | 0 |
| Centurion Shoal | 25 | 20 | 0 | 35 | 48 | 0 |
| Koseir | 26 | 8 | 0 | 34 | 15 | 0 |
| Suez | 30 | 0 | 30 | 32 | 28 | 0 |
| *Var.* 12° 0′ *W.* | | | | | | |
| Tor Harbour | 28 | 19 | 0 | 33 | 28 | 0 |
| Ras Mahomed | 27 | 43 | 0 | 34 | 15 | 0 |
| Bareedy Harbour | 24 | 17 | 0 | 37 | 45 | 0 |
| Yambo | 24 | 10 | 0 | 38 | 21 | 0 |
| Juddah | 21 | 29 | 0 | 39 | 15 | 0 |
| Camfidia | 19 | 7 | 0 | 40 | 50 | 0 |
| Marabia Reefs, | | | | | | |
| — Western Part | 19 | 11 | 0 | 40 | 5 | 0 |
| Loheia | 15 | 44 | 0 | 42 | 44 | 0 |
| Cape Israel | 15 | 15 | 0 | 42 | 41 | 0 |
| Gebel Tor | 15 | 32 | 0 | 42 | 0 | 0 |
| *Var.* 8° 30′ *W.* | | | | | | |
| Gebel Zebayr | 15 | 3 | 0 | 42 | 18 | 0 |
| Gebel Zeghir | 14 | 2 | 0 | 42 | 52 | 0 |
| Mocha | 13 | 20 | 0 | 43 | 20 | 0 |
| *Var.* 9° 20′ *W.* | | | | | | |
| *Coast of Arabia.* | | | | | | |
| Cape St. Anthony | 12 | 30 | 0 | 44 | 16 | 30 |
| Cape Aden | 12 | 46 | 0 | 45 | 10 | 30 |
| *Var.* 8° 40′ *W.* | | | | | | |
| Cape Bogatshua | 14 | 51 | 0 | 50 | 3 | 0 |
| Kisseen Point | 15 | 19 | 30 | 51 | 40 | 0 |
| Cape Fartak | 15 | 37 | 30 | 52 | 11 | 0 |
| Cape Morebat | 16 | 55 | 0 | 54 | 42 | 50 |
| Ras Jingera | 17 | 6 | 50 | 55 | 2 | 0 |
| Ras Noss | 17 | 23 | 0 | 55 | 10 | 30 |
| Curia Muria Isles, | | | | | | |
| — Jibly | 17 | 26 | 20 | 56 | 16 | 0 |
| — Hallanny, N.E. Pt. | 17 | 31 | 15 | 56 | 0 | 0 |
| — Soda | 17 | 28 | 0 | 55 | 49 | 0 |

| (44) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Coast of Arabia.* | | | | | | |
| — Hasky | 17 | 29 | 30 | 55 | 30 | 0 |
| Ras Garwow or Cape Chancily | 17 | 51 | 50 | 56 | 16 | 10 |
| Ras Madrake or Cape Isolette | 18 | 58 | 0 | 57 | 45 | 30 |
| Massera Island, | | | | | | |
| — South Point | 20 | 7 | 35 | 58 | 33 | 0 |
| — North Point | 20 | 40 | 10 | 58 | 48 | 35 |
| Ras Jibsh | 21 | 25 | 50 | 59 | 6 | 30 |
| Ras al Hubba | 22 | 14 | 30 | 59 | 44 | 20 |
| Ras al Had or Cape Rosalgat | 22 | 33 | 10 | 59 | 43 | 10 |
| *Var.* 6° 10′ *W.* | | | | | | |
| Muskat | 23 | 37 | 5 | 58 | 30 | 20 |
| Burka | 23 | 41 | 30 | 57 | 49 | 0 |
| Schenas | 24 | 45 | 0 | 56 | 33 | 0 |
| *Persian Side of the Gulf of Persia.* | | | | | | |
| Ormus, Fort | 27 | 7 | 0 | 56 | 37 | 0 |
| Larck, Hill | 26 | 52 | 0 | 56 | 28 | 0 |
| Kishma Island, | | | | | | |
| — Kishma, Town | 26 | 57 | 0 | 56 | 24 | 30 |
| — Luft | 26 | 55 | 0 | 55 | 55 | 0 |
| Angar or Anguam I., | | | | | | |
| — N. Point | 26 | 41 | 0 | 55 | 57 | 0 |
| — S. W. Point | 26 | 32 | 0 | 55 | 22 | 0 |
| Great Tumb Island | 26 | 17 | 0 | 55 | 20 | 0 |
| Bomosa Island | 25 | 51 | 0 | 55 | 6 | 0 |
| Polior or Belior I., mid. | 26 | 18 | 0 | 54 | 40 | 0 |
| Kaez or Kush Island | 26 | 29 | 0 | 54 | 8 | 0 |
| Hinderabia | 26 | 40 | 0 | 53 | 39 | 0 |
| Busheeb, W. Point | 26 | 48 | 0 | 53 | 7 | 0 |
| Crescent Shoal | 26 | 44 | 0 | 51 | 43 | 0 |
| Cape Budistan | 27 | 58 | 0 | 51 | 19 | 0 |
| Zezarini Island | 27 | 57 | 0 | 50 | 17 | 0 |
| Keyn Island | 27 | 45 | 0 | 50 | 7 | 0 |
| Busheer | 29 | 0 | 0 | 50 | 54 | 0 |
| *Var.* 4° 40′ *W.* | | | | | | |
| Karack Island, For | 29 | 15 | 45 | 50 | 19 | 0 |
| Basra or Bussora | 30 | 29 | 30 | 47 | 40 | 0 |
| Phelechi I., S. E. end | 29 | 23 | 0 | 48 | 19 | 0 |
| Graen | 29 | 22 | 30 | 47 | 58 | 0 |
| Khubber Island | 29 | 4 | 0 | 48 | 24 | 0 |
| Garwow Island | 28 | 49 | 0 | 48 | 42 | 0 |
| Malmaradam Island | 28 | 40 | 0 | 48 | 35 | 0 |
| *Arabian Side of the Gulf of Persia.* | | | | | | |
| Ras-ul-Lur | 29 | 21 | 0 | 48 | 5 | 0 |
| Ras-ul-Zoor | 28 | 44 | 0 | 48 | 16 | 0 |
| Durable Shoal, W. end | 27 | 2 | 0 | 50 | 10 | 0 |
| Katif Bay | 26 | 36 | 30 | 50 | 12 | 0 |
| Barhrein I, anch. off | 26 | 15 | 30 | 50 | 40 | 0 |
| *Var.* 5° 40′ *W.* | | | | | | |
| Koor Hussan | 26 | 4 | 30 | 51 | 11 | 0 |
| Ras Reccan | 26 | 11 | 0 | 51 | 17 | 0 |
| Sandy Island | 27 | 52 | 0 | 49 | 25 | 0 |
| Hawlool | 25 | 40 | 15 | 52 | 26 | 0 |
| Sherarow | 25 | 2 | 0 | 52 | 18 | 0 |
| Daeny | 24 | 58 | 30 | 52 | 35 | 0 |
| Seir Beni Yass | 24 | 18 | 0 | 52 | 46 | 0 |
| Dalmy, S. end | 24 | 27 | 30 | 52 | 27 | 0 |
| Arzenie | 24 | 48 | 0 | 52 | 42 | 15 |
| Jernain | 24 | 56 | 0 | 52 | 59 | 45 |
| Dauss | 25 | 8 | 30 | 53 | 0 | 45 |
| Zircoon or Zara | 24 | 52 | 0 | 53 | 13 | 15 |

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## LATITUDES AND LONGITUDES.

| (45) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Arabian Side of the Gulf of Persia.* | | | | | | |
| Seir Abonaid | 25 | 14 | 0 | 54 | 22 | 0 |
| Ras Luffan | 25 | 54 | 30 | 51 | 36 | 0 |
| Ras-el-Allarch | 25 | 0 | 0 | 51 | 38 | 30 |
| Jezurab-ain-Lassart | 24 | 46 | 0 | 51 | 37 | 0 |
| Ras Boogmais | 24 | 34 | 30 | 51 | 31 | 0 |
| Goodwin's Islands | 24 | 35 | 0 | 51 | 43 | 0 |
| Yassaret Islands | 24 | 14 | 0 | 51 | 58 | 0 |
| Ras-el-Machereeb | 24 | 17 | 0 | 51 | 45 | 0 |
| Jibbub Hadwareah | 24 | 12 | 0 | 52 | 47 | 0 |
| Stanner's Shoal, N. end | 24 | 40 | 0 | 53 | 17 | 0 |
| Mount Jibbul Alli | 25 | 2 | 0 | 55 | 14 | 0 |
| Abothubbee | 24 | 29 | 0 | 54 | 32 | 0 |
| Debai | 25 | 16 | 30 | 55 | 24 | 45 |
| Sharga | 25 | 21 | 45 | 55 | 29 | 15 |
| Aymaun | 25 | 25 | 15 | 55 | 33 | 0 |
| Amulgawein | 25 | 35 | 15 | 55 | 41 | 45 |
| Red Island, Town | 25 | 43 | 0 | 55 | 55 | 15 |
| Ras-el-Khyma | 25 | 48 | 15 | 56 | 4 | 15 |
| Raumps | 25 | 53 | 0 | 56 | 8 | 30 |
| Shaum, Towers | 26 | 2 | 0 | 56 | 11 | 15 |
| Boukha Point | 26 | 9 | 30 | 56 | 14 | 15 |
| Cape Jedda or Yeddu | 26 | 13 | 45 | 56 | 16 | 30 |
| Ras Sheik Mumoud | 26 | 16 | 15 | 56 | 19 | 0 |
| Perforated Rock | 26 | 23 | 54 | 56 | 27 | 32 |
| Great Quoin | 26 | 30 | 25 | 56 | 34 | 20 |
| Cape Musseldom | 26 | 23 | 45 | 56 | 35 | 10 |
| Cape Jask | 25 | 38 | 0 | 58 | 10 | 0 |
| Churbar | 25 | 15 | 0 | 61 | 20 | 0 |
| Cape Gwadur | 25 | 4 | 0 | 62 | 12 | 0 |
| Cape Arubah | 25 | 7 | 0 | 65 | 24 | 0 |
| Cape Monze | 24 | 51 | 0 | 66 | 50 | 0 |
| Point Jigut | 22 | 20 | 0 | 69 | 16 | 0 |
| Diu Head | 20 | 42 | 0 | 71 | 6 | 30 |
| Scarbett Island | 20 | 55 | 30 | 71 | 43 | 30 |
| Cambay | 22 | 24 | 0 | 72 | 48 | 0 |
| Surat, Castle | 21 | 11 | 0 | 73 | 2 | 34 |
| Vaux's Tomb | 21 | 4 | 30 | 72 | 48 | 44 |
| *Var.* 0° 30′ *W.* | | | | | | |
| Damaun | 20 | 22 | 0 | 73 | 2 | 45 |
| Omergon | 20 | 10 | 30 | 72 | 54 | 30 |
| St. John's High Land | 20 | 3 | 0 | 72 | 49 | 0 |
| Basseen Fort | 19 | 19 | 0 | 72 | 55 | 24 |
| Bombay, Flag Staff | 18 | 55 | 48 | 72 | 54 | 24 |
| — Lighthouse | 18 | 53 | 45 | 72 | 52 | 54 |
| *Var.* 1° 0′ *W.* | | | | | | |
| Henery & Kenery Is. | 18 | 42 | 20 | 72 | 53 | 0 |
| Coullaba Island | 18 | 37 | 20 | 72 | 56 | 30 |
| Chaoul | 18 | 32 | 30 | 73 | 0 | 0 |
| Bancoot | 17 | 56 | 40 | 73 | 7 | 54 |
| Severndroog | 17 | 47 | 30 | 73 | 9 | 0 |
| Dabul | 17 | 46 | 0 | 73 | 11 | 0 |
| Zyghur Point | 17 | 16 | 0 | 73 | 14 | 30 |
| Geriah | 16 | 31 | 0 | 73 | 22 | 24 |
| Angria's Bank, mid. | 16 | 28 | 0 | 72 | 7 | 0 |
| Vingorla Rocks | 15 | 51 | 0 | 73 | 33 | 0 |
| Goa | 15 | 28 | 20 | 73 | 53 | 30 |
| Alguado Point | 15 | 29 | 30 | 73 | 48 | 39 |
| St. George's Island | 15 | 22 | 0 | 73 | 48 | 0 |
| Cape Ramas | 15 | 5 | 0 | 74 | 1 | 0 |
| Oyster Rocks | 14 | 48 | 0 | 74 | 8 | 0 |
| Carwar Head | 14 | 47 | 0 | 74 | 12 | 30 |

| (46) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Malabar Coast.* | | | | | | |
| Anje-dwa | 14 | 44 | 0 | 74 | 12 | 30 |
| Merjee River | 14 | 30 | 0 | 74 | 24 | 30 |
| Onore | 14 | 16 | 0 | 74 | 34 | 0 |
| Fortified Island | 14 | 19 | 0 | 74 | 29 | 0 |
| Pigeon Island | 14 | 2 | 30 | 74 | 27 | 0 |
| Barcelore, Peak | 13 | 50 | 0 | 74 | 55 | 0 |
| St. Mary's Rocks, | | | | | | |
| — Largest | 13 | 31 | 0 | 74 | 40 | 0 |
| Premeira Rocks | 13 | 11 | 0 | 74 | 47 | 0 |
| Mangalore | 12 | 50 | 30 | 75 | 4 | 0 |
| Mount Dilly | 11 | 59 | 0 | 75 | 27 | 0 |
| Cananore | 11 | 51 | 0 | 75 | 37 | 0 |
| Tillicherry | 11 | 44 | 0 | 75 | 45 | 0 |
| Sacrifice Rock | 11 | 30 | 0 | 75 | 47 | 0 |
| Calicut | 11 | 15 | 0 | 76 | 2 | 15 |
| Chitwa, Church | 10 | 32 | 0 | 76 | 17 | 0 |
| Cochin | 9 | 57 | 30 | 76 | 26 | 0 |
| Quilon | 8 | 51 | 30 | 76 | 46 | 30 |
| Anjenja Roads | 8 | 39 | 25 | 76 | 58 | 0 |
| Cape Comorin | 8 | 4 | 0 | 77 | 41 | 30 |
| Manapar Point | 8 | 22 | 0 | 78 | 13 | 30 |
| Punnecoil | 8 | 41 | 0 | 78 | 18 | 0 |
| Point Calymere | 10 | 18 | 30 | 79 | 57 | 0 |
| Negapatam, Fort | 10 | 45 | 30 | 79 | 55 | 0 |
| Five White Pagodas | 10 | 49 | 0 | 78 | 54 | 30 |
| Tranquebar | 11 | 1 | 30 | 79 | 55 | 0 |
| Devicotta | 11 | 24 | 0 | 79 | 52 | 0 |
| Porto Nova | 11 | 31 | 0 | 79 | 49 | 0 |
| Cuddalore | 11 | 43 | 0 | 79 | 50 | 0 |
| Pondicherry | 11 | 55 | 41 | 79 | 53 | 45 |
| Sadras | 12 | 32 | 0 | 80 | 14 | 0 |
| Madras, | | | | | | |
| — Fort St. George | 13 | 4 | 10 | 80 | 21 | 0 |
| *Var.* 0° 35′ *E.* | | | | | | |
| Pullicate, Flagstaff | 13 | 25 | 0 | 80 | 23 | 15 |
| Armegon | 13 | 59 | 0 | 80 | 21 | 0 |
| Point Divy | 15 | 59 | 0 | 81 | 15 | 0 |
| Musilipatam | 16 | 11 | 0 | 81 | 12 | 0 |
| Point Gordewar | 16 | 43 | 0 | 82 | 23 | 0 |
| Coringa | 16 | 49 | 0 | 82 | 19 | 0 |
| Visagapatam | 17 | 42 | 30 | 83 | 24 | 0 |
| Bimlapatam | 17 | 53 | 0 | 83 | 34 | 0 |
| Chicacole | 18 | 12 | 0 | 83 | 58 | 0 |
| Ganjam | 19 | 22 | 30 | 85 | 9 | 0 |
| Jagernaut Pagoda | 19 | 48 | 21 | 85 | 45 | 0 |
| Black Pagoda | 19 | 52 | 15 | 86 | 6 | 0 |
| False Point | 20 | 19 | 38 | 86 | 59 | 40 |
| Point Palmiras | 20 | 41 | 0 | 87 | 11 | 0 |
| Balasore River, ent. | 21 | 28 | 0 | 87 | 12 | 0 |
| Ingerlee Pagoda | 21 | 44 | 0 | 88 | 2 | 0 |
| Kedgeree | 21 | 51 | 0 | 88 | 8 | 0 |
| Western Brace, S end | 21 | 10 | 0 | 87 | 44 | 0 |
| Western Sea Reef, | | | | | | |
| — South end | 20 | 59 | 0 | 88 | 0 | 0 |
| Eastern Sea Reef, | | | | | | |
| — South end | 20 | 58 | 0 | 88 | 19 | 0 |
| Red Reef Buoy | 21 | 13 | 0 | 88 | 13 | 0 |
| Sauger Sand, S. end | 21 | 0 | 0 | 88 | 33 | 0 |
| Sauger Island, S. Pt. | 21 | 34 | 0 | 88 | 12 | 0 |
| Mud Point | 21 | 56 | 0 | 88 | 12 | 0 |
| Calcutta, | | | | | | |
| — Fort William | 22 | 34 | 38 | 88 | 26 | 50 |

*Coromandel Coast.*

*Bengal.*

## LATITUDES AND LONGITUDES.

| | (47) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Chittagong. | Chandernagur | 22 | 51 | 26 | 88 | 28 | 40 |
| | Islamabad or Chittagong | 22 | 21 | 0 | 91 | 49 | 0 |
| Aracan. | Kuttubdes I., N. end | 21 | 55 | 0 | 91 | 48 | 0 |
| | Red Crab Island | 21 | 29 | 0 | 91 | 50 | 0 |
| | Elephant Point | 21 | 10 | 0 | 92 | 4 | 0 |
| | Shapooree Island | 20 | 45 | 0 | 92 | 13 | 0 |
| | St. Martin's Tree I. | 20 | 34 | 0 | 92 | 17 | 0 |
| | Oyster Rock | 20 | 10 | 0 | 92 | 40 | 0 |
| | Mosque Point | 20 | 12 | 0 | 92 | 45 | 0 |
| | Terribles, mid. | 19 | 25 | 0 | 93 | 10 | 0 |
| | Cheduba Rocks | 18 | 58 | 0 | 93 | 20 | 0 |
| | Cheduba | 18 | 49 | 0 | 93 | 34 | 0 |
| | Negamole or Tree I. | 18 | 26 | 0 | 93 | 47 | 0 |
| | Foul Island | 18 | 7 | 0 | 93 | 54 | 0 |
| Ava. | St. John's or Church Rocks | 17 | 28 | 0 | 94 | 7 | 0 |
| | Buffalo Rocks, mid | 16 | 22 | 0 | 94 | 12 | 0 |
| | C. Negrais, Pagoda Pt. | 15 | 58 | 0 | 94 | 16 | 0 |
| | Diamond Island | 15 | 52 | 0 | 94 | 17 | 0 |
| | LaGuarda or SunkenI. | 15 | 41 | 0 | 94 | 12 | 0 |
| Pegu. | Rangoon River, — Elephant Pagoda | 16 | 28 | 0 | 96 | 23 | 45 |
| | Rangoon, Town | 16 | 45 | 0 | 96 | 13 | 0 |
| | *Var.* 2° 48′ *E.* | | | | | | |
| | Martaban, Town | 16 | 31 | 0 | 97 | 26 | 0 |
| | Quekmi Pagoda | 16 | 3 | 0 | 97 | 28 | 0 |
| | Amherst Town | 16 | 3 | 0 | 97 | 31 | 0 |
| | Muscos Islands, S. end | 13 | 43 | 0 | 97 | 50 | 0 |
| | Tavay Point | 13 | 30 | 0 | 98 | 4 | 0 |
| | Tavay, Town | 14 | 0 | 0 | 98 | 4 | 0 |
| | Tavay Island, N. end | 13 | 14 | 30 | 98 | 8 | 0 |
| | Mergui | 12 | 12 | 0 | 98 | 24 | 0 |
| | Tanasserim I., N. end | 12 | 36 | 0 | 97 | 30 | 0 |
| | Cabossa Island | 12 | 46 | 0 | 97 | 29 | 0 |
| | Tores Islands, W. end | 11 | 50 | 0 | 97 | 3 | 0 |
| | Pine Tree Island | 10 | 17 | 0 | 98 | 10 | 0 |
| | Elephant I., N. end | 10 | 5 | 0 | 98 | 6 | 0 |
| | Roe's Bank, N. end | 10 | 2 | 0 | 96 | 40 | 0 |
| | Middle Island | 9 | 3 | 0 | 97 | 50 | 0 |
| | Perforated Island | 8 | 50 | 0 | 97 | 53 | 0 |
| | Seyer Island, S. end | 8 | 28 | 0 | 97 | 48 | 0 |
| | Junkseylon I., S. end | 7 | 46 | 0 | 98 | 20 | 0 |
| | Slipper Island | 7 | 20 | 0 | 98 | 49 | 0 |
| | Pulo Bouton, Dome | 6 | 33 | 0 | 99 | 20 | 30 |
| | Pulo Ladda, Peak | 6 | 21 | 0 | 99 | 50 | 0 |
| | Queda | 6 | 6 | 0 | 100 | 21 | 0 |
| Malay Coast. | Pulo Pera | 5 | 42 | 0 | 99 | 1 | 0 |
| | Pulo Penang or Pr. of Wales Island, — Fort Cornwallis | 5 | 25 | 0 | 100 | 21 | 30 |
| | Salangore Hill | 3 | 20 | 0 | 101 | 17 | 0 |
| | Parcelar Hill | 2 | 51 | 0 | 101 | 25 | 30 |
| | Cape Rachado | 2 | 26 | 0 | 101 | 51 | 0 |
| | Malacca, Fort | 2 | 12 | 0 | 102 | 15 | 0 |
| | Mount Moar | 1 | 59 | 0 | 102 | 41 | 0 |
| | Mount Formosa | 1 | 49 | 0 | 102 | 55 | 0 |
| | Pulo Pisang | 1 | 28 | 0 | 103 | 14 | 0 |
| | Tanjong Boulus | 1 | 15 | 0 | 103 | 31 | 0 |
| | Singapore, Town | 1 | 17 | 22 | 103 | 51 | 0 |
| | Point Romania | 1 | 22 | 30 | 104 | 17 | 0 |
| | Tringany River, entr. | 5 | 21 | 0 | 103 | 4 | 0 |

| | (48) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| | Siam River, entr. | 13 | 29 | 40 | 101 | 15 | 0 |
| | Bankok | 13 | 58 | 30 | 100 | 31 | 0 |
| | Ko-si-chang Hr. | 13 | 12 | 0 | 100 | 55 | 0 |
| | Cambodia R., W. end | 9 | 35 | 0 | 106 | 20 | 0 |
| | — mid. entr. abt. | 9 | 55 | 0 | 106 | 30 | 0 |
| | Cape St. James | 10 | 16 | 41 | 107 | 4 | 15 |
| | Saigon, City | 10 | 50 | 0 | 106 | 43 | 0 |
| | Britto's Bank, center | 10 | 30 | 42 | 107 | 49 | 0 |
| | Point Ke-ga | 10 | 41 | 30 | 108 | 4 | 0 |
| | Pulo Ceicer de Terre | 11 | 13 | 0 | 108 | 48 | 0 |
| | Cape Padaran | 11 | 21 | 0 | 109 | 0 | 0 |
| | False Cape Varella | 11 | 44 | 0 | 109 | 12 | 0 |
| | Camraigne Hr., entr. | 11 | 49 | 0 | 109 | 12 | 0 |
| | Water Islands, S. end | 12 | 2 | 0 | 109 | 19 | 0 |
| | Pyramid Island | 12 | 21 | 0 | 109 | 22 | 0 |
| | Three Kings | 12 | 38 | 0 | 109 | 27 | 0 |
| | Cape Varella | 12 | 55 | 0 | 109 | 24 | 30 |
| | Pulo Cambir | 13 | 33 | 0 | 109 | 30 | 0 |
| | Cape San-ho | 13 | 44 | 0 | 109 | 14 | 0 |
| | Buffalo Island | 14 | 11 | 0 | 109 | 14 | 0 |
| | Pulo Canton | 15 | 23 | 0 | 109 | 4 | 0 |
| | Cape Turon | 16 | 7 | 0 | 108 | 13 | 0 |
| | Cape Choumay | 16 | 22 | 0 | 107 | 52 | 0 |
| | Hue-fo River, entr. | 16 | 36 | 0 | 107 | 16 | 0 |
| | Tiger's Island | 16 | 55 | 0 | 107 | 15 | 0 |
| | Now-chow | 20 | 58 | 0 | 110 | 26 | 0 |
| China. | Tien-pak, — Ty-foong-Kyoh | 21 | 22 | 30 | 111 | 13 | 0 |
| | Ty-chook-chou | 21 | 26 | 0 | 111 | 24 | 0 |
| | Song-yue Point | 21 | 31 | 0 | 111 | 40 | 30 |
| | Hai-ling-shan, — Mamu-chou | 21 | 34 | 0 | 111 | 50 | 0 |
| | Ty-oa Point | 21 | 43 | 0 | 112 | 15 | 0 |
| | Ty-wok | 21 | 39 | 0 | 112 | 7 | 0 |
| | Mandarine's Cap | 21 | 28 | 0 | 112 | 22 | 30 |
| | Mong-chow | 21 | 39 | 0 | 112 | 29 | 0 |
| | Haw-cheun or FalseSt.John, S.W. end | 21 | 35 | 0 | 112 | 31 | 30 |
| | Wy-caup Island | 21 | 34 | 0 | 112 | 47 | 30 |
| | Lieu-chew | 21 | 36 | 0 | 112 | 53 | 0 |
| | Wizard Rocks | 21 | 47 | 0 | 113 | 1 | 30 |
| | Ty-kan Island | 21 | 52 | 0 | 113 | 2 | 0 |
| | Cou-cock I., S.W. Pt. | 21 | 50 | 0 | 113 | 7 | 30 |
| | Tyloo, S. end | 21 | 52 | 30 | 113 | 14 | 30 |
| | Type, Roads | 22 | 8 | 0 | 113 | 32 | 0 |
| | Macoa, Town | 22 | 10 | 30 | 113 | 32 | 0 |
| | Canton, Factory | 23 | 7 | 10 | 113 | 14 | 0 |

## XVI. Islands, Rocks, and Shoals, in the INDIAN OCEAN.

| | South | | | East | | |
|---|---|---|---|---|---|---|
| | ° | ′ | | ° | ′ | |
| Telemaque Rock? | 38 | 12 | 0 | 22 | 0 | 0 |
| Fortune Shoal? | 33 | 8 | 0 | 43 | 5 | 0 |
| Augusta Shoal? | 33 | 44 | 0 | 36 | 16 | 0 |
| Otter's Shoal? | 33 | 56 | 0 | 36 | 0 | 0 |
| Barker's Rock? | 37 | 43 | 0 | 32 | 5 | 0 |
| Dutch Bank? | 37 | 20 | 0 | 36 | 52 | 0 |
| Prince Edward's Isles — North end | 46 | 40 | 0 | 38 | 6 | 0 |

# TABLE LVI.

## LATITUDES AND LONGITUDES.

*West Coast of Madagascar.*

| (49) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| — South end | 46 | 53 | 0 | 37 | 46 | 0 |
| Crozet's or Desert Is, about | 46 | 45 | 0 | 48 | 0 | 0 |
| Necklegal? | 40 | 48 | 0 | 54 | 0 | 0 |
| Kerguelan or Desolation Island, | | | | | | |
| — Christmas Hr. | 48 | 41 | 15 | 69 | 2 | 15 |
| *Var.* 20° 20′ *W.* | | | | | | |
| — Cape Digby | 19 | 23 | 30 | 70 | 32 | 0 |
| — Cape George | 19 | 54 | 30 | 70 | 12 | 15 |
| — Port Paliser | 19 | 3 | 15 | 69 | 35 | 0 |
| St. Paul's Island | 38 | 42 | 0 | 77 | 52 | 0 |
| Amsterdam Island | 37 | 52 | 0 | 77 | 52 | 0 |
| Cloates Island? | 22 | 0 | 0 | 112 | 30 | 0 |
| Tryal Rocks? | 20 | 10 | 0 | 110 | 0 | 0 |
| Christmas Island | 10 | 32 | 0 | 105 | 33 | 0 |
| Cocos or Keelings Is. | | | | | | |
| — Northernmost | 12 | 0 | 0 | 97 | 4 | 0 |
| True Briton's Island? | 9 | 30 | 0 | 89 | 14 | 0 |
| Cape St. Mary | 25 | 38 | 54 | 45 | 1 | 42 |
| *Var.* 21° 0′ *W.* | | | | | | |
| Star Reefs, S. end | 25 | 24 | 30 | 44 | 12 | 36 |
| Leven Island | 25 | 12 | 30 | 44 | 12 | 48 |
| Barracouta Island | 25 | 3 | 0 | 44 | 2 | 12 |
| St. Augustine's Bay, | | | | | | |
| — Sandy Island | 23 | 38 | 24 | 43 | 33 | 12 |
| — Tent Rock | 23 | 35 | 24 | 43 | 40 | 30 |
| Cape St. Vincent | 21 | 54 | 24 | 43 | 15 | 12 |
| Mourondava | 20 | 18 | 18 | 44 | 14 | 12 |
| Cape St. Andrew | 16 | 11 | 24 | 44 | 25 | 48 |
| Boyanna Bay, N. ent. | 15 | 59 | 0 | 45 | 18 | 12 |
| Bembatooka Bay, | | | | | | |
| — Majunga Point | 15 | 42 | 54 | 46 | 15 | 12 |
| Makumba Island | 15 | 42 | 0 | 45 | 52 | 24 |
| *Var.* 12° 0′ *W.* | | | | | | |
| Majambo Bay, entr. | 15 | 11 | 42 | 46 | 54 | 12 |
| Nareenda Bay, entr. | 14 | 40 | 18 | 47 | 21 | 18 |
| Luza River, entr. | 14 | 36 | 54 | 47 | 37 | 54 |
| Sancasse Island, N.Pt. | 14 | 30 | 42 | 47 | 30 | 0 |
| Mc. Cluer Point | 14 | 15 | 0 | 47 | 44 | 0 |
| Passandava Bay, | | | | | | |
| — Nine Pin Island | 13 | 28 | 12 | 48 | 9 | 48 |
| *Var.* 12° 30′ *W.* | | | | | | |
| Dalrymple Bay, entr. | 13 | 30 | 0 | 47 | 56 | 30 |
| Nos Beh I., N. Pt. | 13 | 12 | 12 | 48 | 13 | 30 |
| Minow Island, N. Pt. | 12 | 49 | 30 | 48 | 33 | 48 |
| Cape St. Sebastian | 12 | 26 | 12 | 48 | 40 | 36 |
| Woody Island | 12 | 16 | 42 | 48 | 36 | 0 |
| Port Liverpool, N. Pt. | 12 | 3 | 18 | 49 | 6 | 12 |
| Cape Amber, N.E.Pt. | 11 | 57 | 30 | 49 | 13 | 48 |
| Diego Suarez Bay, ent. | 12 | 10 | 12 | 49 | 18 | 48 |
| *Var.* 11° 0′ *W.* | | | | | | |
| British Sound, entr. | 13 | 13 | 48 | 49 | 18 | 18 |
| Cape Lowry | 12 | 35 | 0 | 49 | 34 | 36 |
| Port Looké, E, Point | 12 | 44 | 12 | 49 | 41 | 48 |
| Port Leven, | | | | | | |
| — Nosh How Island | 12 | 47 | 48 | 49 | 48 | 12 |
| Andrava Bay, S.E. Pt. | 12 | 56 | 48 | 49 | 51 | 18 |
| Manambatoo | 13 | 14 | 12 | 49 | 53 | 12 |
| Vohemar Point | 13 | 23 | 30 | 49 | 58 | 0 |
| Cape East, Town | 15 | 14 | 24 | 50 | 25 | 12 |

*Eastern Coast of Madagascar Island.*

| (50) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Antongil Bay, | | | | | | |
| — Durnford Noss | 16 | 0 | 0 | 50 | 6 | 12 |
| — Port Choiseul | 15 | 27 | 18 | 49 | 47 | 0 |
| — Mananhar | 16 | 9 | 30 | 49 | 41 | 0 |
| — Cape Bellones | 16 | 14 | 0 | 49 | 48 | 48 |
| Tantang | 16 | 42 | 30 | 49 | 41 | 6 |
| Point Larreé | 16 | 50 | 18 | 49 | 46 | 48 |
| St. Mary's I., N. Pt. | 16 | 40 | 30 | 49 | 59 | 36 |
| — South Point | 17 | 7 | 18 | 49 | 45 | 42 |
| — Isle Madame | 17 | 0 | 0 | 49 | 48 | 48 |
| *Var.* 15° 0′ *W.* | | | | | | |
| Fenerive, Town | 17 | 23 | 0 | 49 | 23 | 0 |
| Foule Point | 17 | 40 | 24 | 49 | 32 | 0 |
| *Var.* 16° 0′ *W.* | | | | | | |
| Plumb Island | 18 | 2 | 48 | 49 | 24 | 0 |
| Tamatave Point | 18 | 10 | 6 | 49 | 23 | 18 |
| Fong Isles | 18 | 26 | 30 | 49 | 20 | 24 |
| Vatoo Madré | 18 | 39 | 48 | 48 | 52 | 48 |
| Manooroo | 19 | 55 | 0 | 48 | 47 | 0 |
| Fanantara | 20 | 51 | 12 | 48 | 28 | 0 |
| Rangazarak | 20 | 58 | 12 | 48 | 27 | 24 |
| Footak | 24 | 4 | 0 | 47 | 26 | 12 |
| Manambatoo | 24 | 17 | 18 | 47 | 19 | 48 |
| Loodatoo | 24 | 36 | 42 | 47 | 12 | 12 |
| St. Luce Bay, N. Isle | 24 | 44 | 42 | 47 | 9 | 0 |
| Point Ytapere | 24 | 59 | 42 | 47 | 2 | 36 |
| Fort Dauphin | 25 | 1 | 18 | 46 | 57 | 0 |
| *Var.* 21° 0′ *W.* | | | | | | |

*Mozambique Channel.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Europa Island or | | | | | | |
| Bassas da India | 22 | 22 | 30 | 40 | 19 | 0 |
| Bassas da India or | | | | | | |
| Europa Rocks, E. Pt. | 21 | 29 | 0 | 39 | 35 | 30 |
| *Var.* 22° 0′ *W.* | | | | | | |
| Barren Islands, | | | | | | |
| — North Island | 18 | 18 | 6 | 43 | 41 | 24 |
| — South Island | 18 | 33 | 54 | 43 | 51 | 0 |
| Coffin Island | 17 | 29 | 0 | 43 | 42 | 0 |
| Juan de Nova | 17 | 3 | 30 | 42 | 42 | 18 |
| Chesterfield Bank | 16 | 17 | 30 | 43 | 50 | 24 |

*Comoro Islands.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Mayotta, Peak | 13 | 11 | 0 | 45 | 11 | 0 |
| — North Point | 12 | 36 | 0 | 45 | 6 | 30 |
| Johanna, Town | 12 | 11 | 0 | 44 | 22 | 18 |
| — Highest peak | 12 | 13 | 30 | 44 | 24 | 18 |
| Mohilla, N. Point | 12 | 13 | 0 | 43 | 43 | 0 |
| *Var.* 12° 30′ *W.* | | | | | | |
| — East Point | 12 | 20 | 0 | 43 | 55 | 30 |
| Comoro, N. E. Point | 11 | 19 | 30 | 43 | 34 | 0 |
| — South East Point | 11 | 54 | 0 | 43 | 28 | 0 |
| — South West Point | 11 | 55 | 0 | 43 | 22 | 0 |
| Glorioso Islands | 11 | 34 | 48 | 47 | 19 | 0 |
| Aldabra Island, E. Pt. | 9 | 26 | 30 | 46 | 29 | 30 |
| — N. W. Point | 9 | 21 | 30 | 46 | 6 | 48 |
| Assumption I., S.E. Pt. | 9 | 46 | 18 | 46 | 28 | 48 |
| *Var.* 13° 42′ *W.* | | | | | | |
| Cosmoledo Group, | | | | | | |
| — North Island | 9 | 38 | 12 | 47 | 36 | 12 |
| — Menai Island | 9 | 42 | 12 | 47 | 32 | 30 |
| — Wizard Island | 9 | 43 | 12 | 47 | 40 | 12 |
| Astove Island | 10 | 6 | 30 | 47 | 43 | 18 |



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## LATITUDES AND LONGITUDES.

| (51) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Seychelle Islands.* | | | | | | |
| Farquhar's Islands or Juan de Nova, | | | | | | |
| — North Island | 10 | 6 | 42 | 51 | 7 | 48 |
| *Var.* 8° 30′ *W.* | | | | | | |
| — Western Island | 10 | 12 | 42 | 50 | 56 | 36 |
| — Southern Island | 10 | 21 | 12 | 51 | 0 | 48 |
| Mac Leod's Bank, | | | | | | |
| — North end | 9 | 53 | 0 | 50 | 21 | 30 |
| — South end | 10 | 0 | 0 | 50 | 19 | 0 |
| St. Pierre I., E. Pt. | 9 | 18 | 42 | 50 | 50 | 48 |
| Providence Island | 9 | 14 | 0 | 51 | 5 | 30 |
| Providence Reef, S end | 9 | 33 | 18 | 50 | 58 | 30 |
| Wizard Breakers | 8 | 50 | 0 | 51 | 7 | 30 |
| *Amirante Islands.* | | | | | | |
| St. Francis | 7 | 9 | 42 | 52 | 41 | 36 |
| Bijoutier | 7 | 3 | 36 | 52 | 42 | 54 |
| Alphonse | 7 | 0 | 30 | 52 | 42 | 36 |
| *Var.* 7° 54′ *W.* | | | | | | |
| Boudeuse | 6 | 10 | 54 | 52 | 51 | 0 |
| De Neuf | 6 | 14 | 0 | 53 | 9 | 12 |
| Marie Louise | 6 | 9 | 0 | 53 | 12 | 42 |
| Etoile | 5 | 47 | 48 | 53 | 3 | 12 |
| Poivre | 5 | 41 | 0 | 53 | 17 | 42 |
| Des Roches, E. Pt. | 5 | 40 | 0 | 53 | 39 | 0 |
| St. Joseph, E. Pt. | 5 | 27 | 30 | 53 | 32 | 24 |
| Daros | 5 | 24 | 36 | 53 | 23 | 24 |
| Eagle | 5 | 7 | 12 | 53 | 23 | 30 |
| African Is., N. Id. | 4 | 53 | 30 | 53 | 28 | 18 |
| — South Island | 4 | 55 | 12 | 53 | 28 | 0 |
| Mahé, Town | 4 | 37 | 30 | 55 | 25 | 0 |
| *Var.* 7° *W.* | | | | | | |
| — S. Point | 4 | 48 | 42 | 55 | 31 | 0 |
| St. Ann's, S. W. Pt. | 4 | 36 | 0 | 55 | 28 | 18 |
| Silhouette, N. Pt. | 4 | 27 | 0 | 55 | 11 | 30 |
| North, N. Pt. | 4 | 22 | 18 | 55 | 12 | 48 |
| La Digue, peak | 4 | 21 | 12 | 55 | 50 | 0 |
| Mary Ann | 4 | 19 | 24 | 55 | 55 | 30 |
| Praslin, W. Pt. | 4 | 17 | 24 | 55 | 39 | 0 |
| Curieuse | 4 | 16 | 12 | 55 | 42 | 12 |
| Aride | 4 | 12 | 30 | 55 | 38 | 30 |
| Reciffe | 4 | 34 | 48 | 55 | 45 | 0 |
| Frigate | 4 | 35 | 12 | 55 | 56 | 0 |
| Dennis | 3 | 48 | 12 | 55 | 38 | 12 |
| Bird | 3 | 42 | 42 | 55 | 10 | 30 |
| French or Swan's Shoal | 4 | 0 | 0 | 54 | 32 | 0 |
| Dupont's Shoal | 4 | 15 | 30 | 54 | 23 | 0 |
| Platte Island | 5 | 51 | 36 | 55 | 23 | 18 |
| Coetivy Island | 7 | 9 | 0 | 56 | 13 | 30 |
| Fortune's Bank | 7 | 7 | 0 | 56 | 57 | 0 |
| Agalega Is., N. end | 10 | 24 | 0 | 56 | 27 | 30 |
| Saya de Malha Bank, | | | | | | |
| — North end, about | 8 | 35 | 0 | 59 | 58 | 0 |
| Tromelin or Sandy I. | 15 | 53 | 12 | 54 | 31 | 18 |
| Cargados Garayos Bk. | | | | | | |
| — Albatross Island | 16 | 11 | 18 | 59 | 40 | 6 |
| — North Island | 16 | 21 | 54 | 59 | 43 | 18 |
| — Establishment | 16 | 25 | 12 | 59 | 41 | 30 |
| — Pearl Island | 16 | 31 | 30 | 59 | 34 | 12 |
| — Cocoa Island | 16 | 47 | 24 | 59 | 35 | 6 |

| (52) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Chagos Archipelago.* | | | | | | |
| Rodrigue Island | 19 | 41 | 0 | 63 | 20 | 0 |
| *Var.* 13° 0′ *W.* | | | | | | |
| Mauritius or Isle of France, | | | | | | |
| — Round Island | 19 | 50 | 30 | 57 | 45 | 0 |
| — Port Louis | 20 | 9 | 56 | 57 | 28 | 41 |
| *Var.* 16° 20′ *W.* | | | | | | |
| — Cape Brabant | 20 | 27 | 0 | 57 | 14 | 0 |
| — Bourbon or Grand Port | 20 | 22 | 0 | 57 | 41 | 0 |
| Bourbon Island, | | | | | | |
| — St. Dennis | 20 | 52 | 30 | 55 | 26 | 30 |
| — St. Paul | 20 | 59 | 50 | 55 | 18 | 54 |
| Speaker's Bank, S. end | 5 | 0 | 0 | 72 | 32 | 0 |
| Sandy Isles | 5 | 17 | 0 | 72 | 39 | 0 |
| Solomon Isles | 5 | 23 | 0 | 72 | 23 | 0 |
| Peros Banhos Islands, | | | | | | |
| —N. E. end | 5 | 16 | 0 | 71 | 57 | 0 |
| Eagle Islands, Northm. | 6 | 11 | 0 | 71 | 29 | 0 |
| Three Brothers | 6 | 9 | 0 | 71 | 39 | 0 |
| Danger Island | 6 | 21 | 0 | 71 | 23 | 0 |
| Six Islands | 6 | 37 | 0 | 71 | 31 | 0 |
| Pitt's Bank, S.W. end | 7 | 27 | 0 | 71 | 21 | 0 |
| Centurion's Bank | 7 | 40 | 0 | 70 | 52 | 0 |
| Ganges Bank | 7 | 26 | 0 | 70 | 59 | 0 |
| Chagos or Diego Garcia Island, S. end | 7 | 29 | 0 | 72 | 27 | 0 |
| Owen's Bank | 6 | 46 | 30 | 70 | 17 | 0 |
| | North | | | | | |
| Bale of Cotton Rock | 5 | 18 | 0 | 88 | 20 | 0 |
| *Maldiva Islands.* | South | | | | | |
| Pona Molulique, | | | | | | |
| — South Side | 0 | 41 | 0 | 73 | 20 | 0 |
| — N. E. Side | 0 | 33 | 0 | 73 | 25 | 0 |
| — Addon Island | 0 | 31 | 0 | 73 | 35 | 0 |
| | North | | | | | |
| Suadiva Atoll, S. Side | 0 | 9 | 0 | 73 | 15 | 0 |
| — N. E. Side | 0 | 59 | 0 | 73 | 34 | 0 |
| Adoumates Atoll, | | | | | | |
| — South Side | 1 | 49 | 0 | 73 | 33 | 0 |
| — N. E. Side | 2 | 9 | 0 | 73 | 46 | 0 |
| — N. W. Side | 2 | 7 | 0 | 73 | 35 | 0 |
| Collomandour Atoll, | | | | | | |
| — South Side | 2 | 13 | 0 | 73 | 21 | 0 |
| — N. W. Side | 2 | 30 | 0 | 73 | 8 | 0 |
| — Long Island | 2 | 21 | 0 | 73 | 8 | 0 |
| Male Atoll, | | | | | | |
| — Maldiva or King's I. | 4 | 10 | 0 | 73 | 42 | 0 |
| Gafor Atoll, N. Side | 4 | 50 | 0 | 73 | 33 | 0 |
| Cardiva Island | 4 | 56 | 0 | 73 | 34 | 0 |
| Todu Island | 4 | 36 | 0 | 73 | 13 | 0 |
| Tilla dou Matis, or Head of the Isles | 7 | 6 | 0 | 73 | 7 | 0 |
| *Laccadive Islands.* | | | | | | |
| Minicoy or Maling I. | 8 | 17 | 0 | 73 | 19 | 0 |
| Kalpeni, center | 10 | 7 | 0 | 73 | 55 | 0 |
| Underoot | 10 | 48 | 0 | 73 | 57 | 0 |
| Elicalpeni Bank | 11 | 15 | 30 | 74 | 17 | 0 |
| Seuhate-par, S. Id. | 10 | 0 | 0 | 72 | 35 | 0 |
| Courutte Island | 10 | 34 | 0 | 72 | 57 | 0 |
| Pittie | 10 | 48 | 0 | 72 | 48 | 0 |

## LATITUDES AND LONGITUDES.

| (53) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Laccadive Islands.* Cardamum | 11 | 14 | 0 | 73 | 10 | 0 |
| Kittan | 11 | 29 | 0 | 73 | 21 | 0 |
| Chittae | 11 | 42 | 0 | 73 | 1 | 0 |
| Aucutta, center | 10 | 51 | 30 | 72 | 28 | 0 |
| Bingaro | 10 | 55 | 0 | 72 | 35 | 0 |
| Peremul-par | 11 | 9 | 0 | 72 | 26 | 0 |
| Betra-par | 11 | 35 | 0 | 72 | 31 | 0 |
| Cherbaniani Bank, — Breakers on the W. extr. | 12 | 22 | 0 | 72 | 7 | 0 |
| *Ceylon Island.* Colombo | 6 | 57 | 0 | 79 | 57 | 0 |
| Adam's Peak | 6 | 52 | 30 | 80 | 34 | 30 |
| Point de Galle, Flagst. | 6 | 1 | 0 | 80 | 18 | 0 |
| Matura | 5 | 58 | 0 | 80 | 38 | 0 |
| Dondra Head | 5 | 56 | 0 | 80 | 41 | 0 |
| Great Basses | 6 | 7 | 0 | 81 | 36 | 0 |
| Little Basses | 6 | 21 | 0 | 81 | 49 | 0 |
| Aganis, South part | 6 | 50 | 0 | 81 | 59 | 0 |
| Baticolo | 7 | 44 | 0 | 81 | 50 | 0 |
| Friar's Hood | 7 | 25 | 0 | 81 | 42 | 0 |
| Venloo's Bay | 7 | 57 | 0 | 81 | 41 | 0 |
| Foul Point | 8 | 30 | 0 | 81 | 26 | 15 |
| Trincomale, — Flagstaff *Var.* 1° 9′ *W.* | 8 | 33 | 30 | 81 | 21 | 0 |
| Pigeon Island | 8 | 41 | 0 | 81 | 20 | 0 |
| Molewal House | 9 | 13 | 0 | 80 | 56 | 30 |
| Palmeira Point | 9 | 48 | 50 | 80 | 23 | 0 |
| Point Pedro | 9 | 49 | 35 | 80 | 20 | 0 |
| *Andaman Islands.* Preparis I., S. end | 14 | 49 | 0 | 93 | 40 | 0 |
| Great Coco, center | 14 | 5 | 0 | 93 | 26 | 30 |
| Little Coco, center | 13 | 58 | 30 | 93 | 18 | 0 |
| Great Andaman, — C. Price, N.E. Pt. | 13 | 34 | 0 | 93 | 9 | 0 |
| — Port Cornwallis, ent. | 13 | 18 | 0 | 93 | 11 | 0 |
| — South end | 11 | 30 | 0 | 92 | 56 | 0 |
| North Centinel, center | 11 | 33 | 0 | 92 | 24 | 0 |
| Little Centinel | 11 | 0 | 0 | 92 | 21 | 0 |
| Sisters | 11 | 10 | 0 | 92 | 58 | 0 |
| Little Andaman, S. end | 10 | 26 | 0 | 92 | 40 | 0 |
| Flat Rock | 11 | 8 | 0 | 93 | 40 | 0 |
| Barren Island | 12 | 17 | 0 | 93 | 54 | 0 |
| Narcondam | 13 | 24 | 0 | 94 | 12 | 0 |
| *Nicobar Islands.* Car-Nicobar | 9 | 10 | 0 | 92 | 56 | 0 |
| Batty Malve | 8 | 46 | 30 | 93 | 2 | 0 |
| Chowry | 8 | 28 | 30 | 93 | 12 | 0 |
| Terressa, S. Point | 8 | 13 | 0 | 93 | 20 | 0 |
| Katchall, W. Point | 7 | 54 | 0 | 93 | 29 | 0 |
| Noncowry Harbour | 8 | 0 | 0 | 93 | 41 | 0 |
| Meroe | 7 | 29 | 0 | 93 | 46 | 0 |
| Great Nicobar, S. end | 6 | 45 | 0 | 94 | 0 | 0 |

## XVII. Islands, Rocks, and Shoals, between the INDIAN and PACIFIC OCEANS, from Sumatra to New Guinea.

| | | | | | | |
|---|---|---|---|---|---|---|
| Pulo Rondo | 6 | 4 | 30 | 95 | 14 | 0 |
| Fulo Brasse, N. Point | 5 | 46 | 0 | 95 | 6 | 0 |
| — East Point | 5 | 42 | 0 | 95 | 13 | 0 |

| (54) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Islands near the Western Coast of Sumatra.* Pulo Way, E. Point | 5 | 46 | 0 | 95 | 27 | 0 |
| — West end | 5 | 48 | 0 | 95 | 18 | 0 |
| Pulo Nancy, E. Point | 5 | 49 | 0 | 95 | 17 | 0 |
| Cocos Isles | 3 | 6 | 0 | 95 | 32 | 0 |
| Hog I., N.W. Point | 2 | 50 | 0 | 95 | 50 | 0 |
| — South end | 2 | 21 | 0 | 96 | 18 | 0 |
| Western Banjack, — South Point | 2 | 0 | 0 | 96 | 54 | 0 |
| Passage Island | 2 | 22 | 0 | 97 | 24 | 0 |
| Pulo Nias, N.W. Pt. | 1 | 36 | 0 | 96 | 55 | 0 |
| — South East Point | 0 | 38 | 0 | 97 | 42 | 0 |
| Pulo Lacotta | 1 | 44 | 0 | 98 | 0 | 0 |
| Claps Island | 0 | 4 | 0 | 97 | 36 | 0 |
| | South | | | | | |
| Pulo Mintao, N. end | 0 | 1 | 0 | 98 | 6 | 0 |
| — South end | 0 | 41 | 0 | 98 | 10 | 0 |
| Se Booro, N. Point | 0 | 56 | 0 | 98 | 30 | 0 |
| — South Point | 1 | 47 | 0 | 99 | 6 | 0 |
| Se Pora, N. end | 2 | 0 | 0 | 99 | 44 | 0 |
| — Point Marlborough | 2 | 25 | 0 | 99 | 56 | 0 |
| North Poggy, N. Point | 2 | 32 | 0 | 100 | 0 | 0 |
| — South West Point | 2 | 52 | 0 | 99 | 57 | 0 |
| South Poggy, N. Pt. | 2 | 50 | 0 | 100 | 14 | 0 |
| — South Point | 3 | 20 | 0 | 100 | 34 | 0 |
| Trieste Island | 4 | 3 | 0 | 101 | 22 | 0 |
| Engano I., N. Point | 5 | 15 | 0 | 102 | 25 | 0 |
| — South Point | 5 | 30 | 50 | 102 | 29 | 15 |
| — S. E. Point | 5 | 30 | 15 | 102 | 38 | 15 |
| *Western Coast of Sumatra.* Flat Point | 6 | 0 | 0 | 104 | 40 | 0 |
| Little Fortune Island | 5 | 56 | 0 | 104 | 32 | 0 |
| Bencoonat | 5 | 35 | 0 | 104 | 17 | 0 |
| Crooe | 5 | 15 | 0 | 104 | 2 | 0 |
| Pulo Pisang | 5 | 12 | 0 | 103 | 53 | 30 |
| Cawoor | 4 | 56 | 0 | 103 | 36 | 0 |
| Manna Point | 4 | 33 | 0 | 103 | 8 | 0 |
| Buffalo Point | 3 | 58 | 0 | 102 | 29 | 0 |
| Bencoolen, — Fort Marlborough | 3 | 48 | 0 | 102 | 28 | 0 |
| Moco-moco | 2 | 35 | 0 | 101 | 21 | 0 |
| Indrapour Point | 2 | 12 | 0 | 100 | 52 | 0 |
| Pulo Marra | 1 | 12 | 0 | 100 | 10 | 0 |
| Padang Head | 0 | 56 | 0 | 100 | 12 | 0 |
| Priaman | 0 | 40 | 0 | 100 | 6 | 0 |
| Massang Point | 0 | 17 | 0 | 99 | 41 | 0 |
| | North | | | | | |
| Mount Ophir | 0 | 4 | 58 | 100 | 0 | 15 |
| Ayer Bongy | 0 | 11 | 42 | 99 | 21 | 15 |
| Natal | 0 | 33 | 26 | 99 | 1 | 45 |
| Tappanooly Bay *Var.* 1° 18′ *E.* | 1 | 40 | 0 | 98 | 55 | 0 |
| Sinkel River | 2 | 13 | 0 | 97 | 39 | 0 |
| Bancoongong | 2 | 52 | 0 | 97 | 18 | 0 |
| Soosoo, Town | 3 | 41 | 0 | 96 | 36 | 0 |
| Cape Felix | 3 | 43 | 0 | 96 | 20 | 0 |
| Analaboo | 4 | 8 | 32 | 96 | 0 | 0 |
| Acheen Head | 5 | 36 | 0 | 95 | 21 | 0 |
| Acheen | 5 | 35 | 0 | 95 | 26 | 0 |
| Golden Mountain | 5 | 27 | 0 | 95 | 40 | 0 |
| Pedir, Village | 5 | 22 | 30 | 96 | 15 | 0 |
| Pedir Point | 5 | 29 | 0 | 96 | 10 | 0 |
| Teolo Samwer Point | 5 | 13 | 0 | 97 | 14 | 0 |

## LATITUDES AND LONGITUDES.

*East Coast of Sumatra.*

| (55) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Diamond Point | 5 | 17 | 0 | 97 | 33 | 0 |
| Prauhilih Point | 4 | 53 | 0 | 97 | 55 | 0 |
| Quala Bubon | 4 | 1 | 0 | 98 | 29 | 0 |
| Delhi River | 3 | 46 | 30 | 98 | 42 | 30 |
| Battoo Barra River | 3 | 13 | 15 | 99 | 37 | 0 |
| Assarhan River | 3 | 1 | 30 | 99 | 52 | 0 |
| Reccan River, | | | | | | |
| — Pulo Lalang Besar | 2 | 10 | 0 | 100 | 37 | 0 |
| Pulo Roupat, N. Pt. | 2 | 6 | 0 | 101 | 42 | 0 |
| Pulo Bucalisse, | | | | | | |
| — Tanjong Jatta | 1 | 36 | 0 | 102 | 0 | 0 |
| Siak River, entr. | 1 | 13 | 0 | 102 | 10 | 0 |
| Carmpou River, entr. | 0 | 35 | 0 | 102 | 8 | 0 |
| Tanjong Barroo | 0 | 1 | 0 | 103 | 49 | 0 |
| | South | | | | | |
| Tanjong Bassoo | 0 | 20 | 0 | 103 | 48 | 0 |
| Tanjong Bon | 0 | 59 | 30 | 104 | 24 | 0 |
| P Varela or Barallah | 0 | 50 | 0 | 104 | 28 | 0 |
| Batacarang Point | 2 | 0 | 0 | 104 | 53 | 0 |
| Third Point | 2 | 23 | 0 | 105 | 32 | 0 |
| Second Point | 2 | 41 | 0 | 105 | 45 | 0 |
| First Point | 3 | 0 | 0 | 105 | 58 | 0 |
| Lucepara Point | 3 | 15 | 0 | 106 | 0 | 0 |
| Hog Point | 5 | 54 | 0 | 105 | 43 | 30 |
| | North | | | | | |
| Pulo Bouton Dome | 6 | 33 | 0 | 99 | 20 | 30 |
| Pulo Pera | 5 | 42 | 0 | 99 | 1 | 0 |
| Pulo Pinang or | | | | | | |
| Pr. of Wales' Island, | | | | | | |
| — Fort Cornwallis | 5 | 25 | 0 | 100 | 21 | 30 |
| Pulo Dinding | 4 | 16 | 0 | 100 | 38 | 0 |
| Sambelang Is., S. end | 4 | 3 | 0 | 100 | 35 | 0 |
| Pulo Jarra | 4 | 0 | 0 | 100 | 12 | 0 |
| Pulo Varela | 3 | 47 | 0 | 99 | 33 | 0 |
| Brothers, | | | | | | |
| — Pulo Pandan | 3 | 24 | 0 | 99 | 49 | 0 |
| Round Arroa | 2 | 49 | 0 | 100 | 40 | 0 |
| Long Arroa | 2 | 52 | 30 | 100 | 35 | 0 |
| North Bank, N.W. end | 3 | 16 | 0 | 100 | 50 | 0 |
| 2½ Fathoms Bank | 2 | 53 | 0 | 101 | 3 | 0 |
| Little Carimon, N. end | 1 | 8 | 30 | 103 | 25 | 0 |
| Tree Island | 1 | 7 | 30 | 103 | 36 | 0 |
| Barn Island | 1 | 9 | 0 | 103 | 41 | 0 |
| Aligator I., N. end | 1 | 10 | 30 | 103 | 40 | 0 |
| St. John's I., S. Pt. | 1 | 13 | 0 | 103 | 51 | 30 |
| Bintang Hill | 1 | 5 | 0 | 104 | 29 | 0 |
| Pedro Branco | 1 | 20 | 0 | 104 | 25 | 30 |
| Pulo Panjang, W. Pt. | 1 | 2 | 0 | 104 | 47 | 0 |
| Ragged Island | 0 | 56 | 30 | 104 | 56 | 30 |
| Geldria's Shoal | 0 | 48 | 0 | 104 | 59 | 0 |
| Strait of Dryon, | | | | | | |
| — Red Island | 0 | 50 | 50 | 103 | 38 | 15 |
| *Var.* 1° 56′ *E.* | | | | | | |
| — South Brother | 0 | 34 | 0 | 103 | 48 | 0 |
| | South | | | | | |
| Calantiga Island | 0 | 29 | 0 | 104 | 5 | 0 |
| Pulo Varella or | | | | | | |
| Barallah | 0 | 50 | 0 | 104 | 28 | 0 |
| Lingen Island, E. Pt. | 0 | 18 | 0 | 105 | 4 | 0 |
| Ilchester's Shoal | 0 | 28 | 0 | 105 | 3 | 0 |
| Pulo Taya | 0 | 45 | 30 | 104 | 58 | 0 |

*Strait of Singapore. Strait of Malacca.*

*Entrance to the China Sea.*

| (56) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Pulo Toty | 0 | 58 | 0 | 105 | 42 | 0 |
| The Seven Islands | 1 | 8 | 0 | 105 | 24 | 0 |
| Frederick Henry Rock | 1 | 55 | 30 | 105 | 2 | 30 |
| Banka Island, | | | | | | |
| — Monopin Hill | 2 | 0 | 0 | 105 | 14 | 0 |
| — Point Lallary | 2 | 49 | 0 | 105 | 55 | 0 |
| — Entrance Point | 3 | 2 | 0 | 106 | 54 | 0 |
| — Brekat Point | 2 | 35 | 0 | 106 | 52 | 0 |
| — Tanjong Riah | 1 | 55 | 0 | 106 | 14 | 0 |
| — Tanjong Muncooda | 1 | 28 | 30 | 105 | 57 | 0 |
| — Goonong Marass, | | | | | | |
| Peak | 1 | 53 | 0 | 105 | 52 | 0 |
| — Tanjong Goonting | 1 | 43 | 0 | 105 | 21 | 0 |
| Lucepara Island | 3 | 13 | 0 | 106 | 10 | 0 |
| Fairlee Rock | 3 | 27 | 0 | 107 | 1 | 0 |
| Pulo Leat, center | 2 | 52 | 0 | 107 | 3 | 0 |
| Alceste Rock | 2 | 46 | 0 | 107 | 3 | 0 |
| Discovery Rock | 2 | 52 | 0 | 106 | 56 | 0 |
| Gaspar Island | 2 | 25 | 30 | 107 | 6 | 0 |
| Canning's Rock | 2 | 23 | 0 | 107 | 14 | 0 |
| Vansittart's Shoal, | | | | | | |
| — South end | 3 | 11 | 0 | 107 | 7 | 0 |
| Billiton I., S. E. Pt. | 3 | 22 | 0 | 108 | 12 | 0 |
| — S. W. Point | 3 | 18 | 0 | 107 | 30 | 0 |
| — N. E. Point | 2 | 40 | 0 | 108 | 20 | 0 |
| West Island | 2 | 30 | 0 | 107 | 36 | 0 |
| Shoe Island | 3 | 47 | 30 | 108 | 2 | 0 |
| Discovery's W. Bank | 3 | 39 | 0 | 108 | 43 | 0 |
| Discovery's Reef | 3 | 36 | 30 | 108 | 48 | 30 |
| Discovery's E. Bank | 3 | 32 | 40 | 109 | 9 | 43 |
| Fox's Bank | 3 | 32 | 0 | 110 | 4 | 0 |
| Osterly's Shoal | 3 | 19 | 0 | 108 | 40 | 30 |
| Scharvogel's Is., S. end | 3 | 22 | 0 | 108 | 26 | 0 |
| Cirencester's Bank | 3 | 17 | 0 | 109 | 4 | 54 |
| Cirencester's Shoal | 2 | 54 | 30 | 108 | 58 | 30 |
| Montarin Islands, | | | | | | |
| — Toekoekemou I. | 2 | 30 | 45 | 108 | 36 | 30 |
| — East Island | 2 | 30 | 45 | 108 | 51 | 45 |
| Ontario's Reef | 2 | 1 | 15 | 108 | 39 | 15 |
| Souroutou, W. end | 1 | 42 | 0 | 108 | 41 | 30 |
| Caremata, Peak | 1 | 36 | 30 | 108 | 54 | 30 |
| — N. W. end | 1 | 33 | 0 | 108 | 49 | 0 |
| Greig's Shoal, mid. | 0 | 55 | 0 | 108 | 37 | 0 |
| | North | | | | | |
| St. Barbe | 0 | 7 | 0 | 107 | 15 | 0 |
| Direction Island | 0 | 15 | 0 | 108 | 5 | 0 |
| Pulo Dattoo | 0 | 7 | 0 | 108 | 36 | 0 |
| St. Esprit Is., E. end | 0 | 34 | 0 | 107 | 13 | 30 |
| Welstead's Rock | 0 | 32 | 0 | 107 | 55 | 0 |
| St. Julian's Island | 0 | 54 | 0 | 106 | 48 | 0 |
| Tumbelan Is., E. end | 1 | 0 | 0 | 107 | 35 | 0 |
| Europe's Shoal | 1 | 12 | 0 | 107 | 24 | 0 |
| Victory's Island | 1 | 34 | 0 | 106 | 22 | 0 |
| Acasta Rock | 1 | 39 | 0 | 106 | 21 | 0 |
| Pulo Tingy | 2 | 17 | 0 | 104 | 11 | 0 |
| Pulo Aor | 2 | 29 | 30 | 104 | 34 | 30 |
| Pulo Pisang | 2 | 37 | 0 | 104 | 23 | 0 |
| Pulo Timoan, N. Pt. | 2 | 54 | 0 | 104 | 15 | 0 |
| — South Point | 2 | 44 | 0 | 104 | 15 | 0 |
| Pulo Varella | 3 | 16 | 0 | 103 | 48 | 0 |
| Pulo Domar | 2 | 45 | 0 | 105 | 23 | 0 |
| White Rock | 2 | 18 | 0 | 105 | 33 | 0 |

## LATITUDES AND LONGITUDES.

| (57) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Entrance to the China Sea.* Saddle Island | 2 | 27 | 0 | 105 | 44 | 0 |
| South Anambas, | | | | | | |
| — Southern Island | 2 | 18 | 0 | 106 | 12 | 0 |
| Middle Anambas, | | | | | | |
| — West Island | 3 | 9 | 0 | 105 | 37 | 0 |
| North Anambas, | | | | | | |
| — N. E. end | 3 | 27 | 0 | 106 | 15 | 0 |
| Low or Separate I. | 3 | 1 | 0 | 107 | 48 | 0 |
| North Haycock Island | 3 | 19 | 0 | 107 | 34 | 0 |
| Peaked Island | 3 | 54 | 0 | 107 | 53 | 0 |
| N. W. Island | 4 | 7 | 0 | 107 | 52 | 0 |
| Pyramidal Rock | 4 | 8 | 0 | 107 | 27 | 0 |
| Saddle Island | 4 | 31 | 0 | 107 | 44 | 0 |
| North Natunas, N. end | 4 | 49 | 0 | 108 | 2 | 0 |
| Great Natunas, | | | | | | |
| — East Point | 3 | 58 | 0 | 108 | 26 | 0 |
| — North Point | 4 | 13 | 0 | 108 | 14 | 0 |
| South Natunas, | | | | | | |
| — Flat Island | 3 | 3 | 0 | 108 | 54 | 0 |
| — West Island | 2 | 40 | 0 | 108 | 40 | 0 |
| — East Island | 2 | 40 | 0 | 109 | 26 | 0 |
| — South or High I. | 2 | 26 | 0 | 109 | 12 | 0 |
| South Haycock Island | 2 | 13 | 0 | 108 | 57 | 0 |
| St. Pierre | 1 | 56 | 0 | 108 | 53 | 0 |
| | South | | | | | |
| *Strait of Sunda.* Prince's Island, Peak | 6 | 35 | 0 | 105 | 15 | 0 |
| Crocatoa, Peak | 6 | 8 | 30 | 105 | 25 | 30 |
| Pulo Besse | 5 | 57 | 0 | 105 | 28 | 30 |
| Thwart the Way, | | | | | | |
| —N. E. Point | 5 | 55 | 30 | 105 | 51 | 0 |
| North Island | 5 | 41 | 0 | 105 | 49 | 0 |
| Three Sisters | 5 | 44 | 0 | 105 | 48 | 0 |
| Button | 5 | 53 | 0 | 105 | 55 | 0 |
| Cap | 5 | 59 | 40 | 105 | 55 | 0 |
| Pulo Baby, W. end | 5 | 48 | 0 | 106 | 14 | 0 |
| South Watcher | 5 | 41 | 30 | 106 | 43 | 0 |
| North Watcher | 5 | 12 | 30 | 106 | 32 | 0 |
| Armuyden Bank | 5 | 13 | 30 | 106 | 48 | 0 |
| Brothers, N. end | 5 | 9 | 30 | 106 | 5 | 0 |
| Brouwers Shoals | 5 | 5 | 0 | 106 | 15 | 0 |
| Bumkin Island | 5 | 47 | 0 | 108 | 23 | 0 |
| Pulo Rackit | 5 | 56 | 0 | 108 | 22 | 0 |
| *Java Sea.* Carimon Java Islands, | | | | | | |
| — Peak | 5 | 50 | 0 | 110 | 34 | 0 |
| Lubec Island, mid. | 5 | 49 | 0 | 112 | 48 | 0 |
| Arrogant Shoal | 5 | 12 | 0 | 113 | 0 | 0 |
| Great Solombo, Hill | 5 | 33 | 0 | 114 | 28 | 0 |
| Little Solombo | 5 | 21 | 0 | 114 | 28 | 0 |
| Arentes Island | 5 | 10 | 0 | 114 | 36 | 0 |
| *North Side of Java.* Java Head | 6 | 48 | 0 | 105 | 11 | 0 |
| First Point | 6 | 44 | 0 | 105 | 10 | 0 |
| Mew I., E. Point | 6 | 43 | 0 | 105 | 17 | 0 |
| Second Point | 6 | 36 | 0 | 105 | 24 | 0 |
| Third Point | 6 | 27 | 0 | 105 | 39 | 0 |
| Anger, Town | 6 | 3 | 30 | 105 | 55 | 0 |
| Bantam, or | | | | | | |
| St. Nicholas Point | 5 | 52 | 0 | 106 | 2 | 0 |
| Bantam, Town | 6 | 2 | 0 | 106 | 9 | 0 |
| BATAVIA, Obs. | 6 | 9 | 0 | 106 | 51 | 45 |
| Edam Island | 5 | 57 | 0 | 106 | 53 | 30 |
| Carawang Point | 6 | 1 | 0 | 107 | 3 | 0 |

| (58) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *North Side of Java.* Sedary Point | 5 | 59 | 0 | 107 | 27 | 0 |
| Pamanoekan Point | 6 | 11 | 0 | 107 | 49 | 0 |
| Indramay Point | 6 | 15 | 0 | 108 | 20 | 0 |
| Cheribon, Town | 6 | 47 | 0 | 108 | 36 | 30 |
| — Mount | 6 | 56 | 0 | 108 | 26 | 0 |
| Taggal | 6 | 50 | 0 | 109 | 14 | 0 |
| — Mount | 7 | 22 | 0 | 109 | 19 | 0 |
| Samarang | 6 | 57 | 0 | 110 | 25 | 0 |
| Mandalique Island | 6 | 22 | 0 | 110 | 54 | 0 |
| Rembang | 6 | 42 | 0 | 111 | 19 | 0 |
| Lassem, Hill | 6 | 41 | 0 | 111 | 28 | 0 |
| Lerang Point | 6 | 35 | 0 | 111 | 27 | 30 |
| Panka Point | 6 | 52 | 0 | 112 | 34 | 30 |
| Sourabaya | 7 | 15 | 30 | 112 | 48 | 0 |
| Cape Sedano, E. Pt. | 7 | 49 | 0 | 114 | 24 | 0 |
| Utrich, Fort | 8 | 16 | 0 | 114 | 17 | 0 |
| Balambouang Bay | 8 | 23 | 0 | 114 | 18 | 0 |
| South East Point | 8 | 46 | 0 | 114 | 34 | 0 |
| *South Side of Java.* Nusa Baron Island | 8 | 37 | 0 | 113 | 23 | 0 |
| Segara Wedi Bay | 8 | 25 | 0 | 111 | 43 | 30 |
| Patchican Bay | 8 | 17 | 0 | 111 | 1 | 0 |
| Nusa Cambangan I., | | | | | | |
| — South West Point | 7 | 51 | 0 | 108 | 46 | 0 |
| Chilantaran Point | 7 | 46 | 0 | 107 | 40 | 0 |
| Wine Cooper's Point | 7 | 27 | 0 | 106 | 28 | 0 |
| Palambang Point | 6 | 59 | 0 | 105 | 16 | 0 |
| *Eastern Passages to China.* Madura Island, | | | | | | |
| — N. W. Point | 6 | 53 | 0 | 112 | 45 | 30 |
| — N. E. Point | 6 | 53 | 0 | 113 | 58 | 30 |
| Pondy Island | 7 | 1 | 0 | 114 | 4 | 0 |
| Four Brothers | 7 | 8 | 0 | 115 | 0 | 0 |
| Urk Island | 7 | 15 | 0 | 115 | 13 | 0 |
| Kangelang Island, | | | | | | |
| — North end | 6 | 53 | 0 | 115 | 17 | 30 |
| — South end | 7 | 0 | 0 | 115 | 25 | 30 |
| Antelope's Is., mid. | 7 | 11 | 0 | 115 | 50 | 0 |
| Hasting's Island | 6 | 56 | 0 | 116 | 24 | 0 |
| Bally Island, Peak | 8 | 24 | 0 | 115 | 24 | 0 |
| — S. or Table Point | 8 | 50 | 0 | 115 | 10 | 0 |
| *Var.* 1° 12′ *E.* | | | | | | |
| — N. E. Point | 8 | 18 | 0 | 115 | 43 | 0 |
| Bally Strait, N. ent. | 8 | 6 | 0 | 114 | 22 | 0 |
| Lombock Island, | | | | | | |
| — Isles off N. W. Pt. | 8 | 13 | 0 | 115 | 59 | 0 |
| — Peak | 8 | 21 | 30 | 116 | 26 | 0 |
| — Bally, Town | 8 | 42 | 30 | 116 | 33 | 0 |
| — Peejou Village | 8 | 48 | 0 | 116 | 28 | 0 |
| Sumbaya Island, | | | | | | |
| — Alass | 8 | 44 | 0 | 116 | 48 | 0 |
| — Isles off N. W. Pt. | 8 | 21 | 0 | 116 | 57 | 0 |
| — Sumbawa, Town | 8 | 27 | 0 | 117 | 24 | 0 |
| — Tumbora Mount | 8 | 9 | 0 | 117 | 43 | 0 |
| — Rocky Point | 8 | 8 | 0 | 118 | 36 | 0 |
| — Rugged Point | 8 | 11 | 0 | 118 | 51 | 0 |
| — Sapy, Town | 8 | 34 | 0 | 119 | 2 | 0 |
| Gooning Apée, Peak | 8 | 11 | 0 | 119 | 5 | 0 |
| Comodo I., N. E. Pt. | 8 | 22 | 0 | 119 | 37 | 30 |
| Flores I., S. W. Pt. | 8 | 50 | 0 | 119 | 45 | 0 |
| — Iron Cape, N.E.Pt. | 8 | 5 | 0 | 122 | 52 | 0 |
| Flores Strait, S. entr. | 8 | 40 | 0 | 123 | 3 | 0 |
| Solor Island, Fort | 8 | 27 | 0 | 123 | 22 | 0 |

## LATITUDES AND LONGITUDES.

| (59) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Pulo Comba . . . | 7 | 49 | 0 | 123 | 41 | 0 |
| Lomblen I., Peak . . | 8 | 12 | 0 | 123 | 52 | 0 |
| — East Point . . . | 8 | 14 | 0 | 124 | 0 | 0 |
| Pulo Pantar, N.E. Pt | 8 | 10 | 0 | 124 | 25 | 0 |
| PuloOmbaye, N.W.Pt | 8 | 9 | 0 | 124 | 27 | 0 |
| — East Point . . . | 8 | 17 | 0 | 125 | 15 | 0 |
| Sandalwood I., W. Pt. | 9 | 42 | 0 | 119 | 1 | 45 |
| — South Point . . | 10 | 22 | 0 | 120 | 20 | 0 |
| — East Point . . . | 10 | 0 | 0 | 120 | 45 | 0 |
| — Baring's Bay . . | 9 | 37 | 0 | 120 | 16 | 0 |
| — North West Point | 9 | 18 | 0 | 119 | 13 | 0 |
| Savu Island, mid.. . | 10 | 37 | 0 | 122 | 0 | 0 |
| New Island . . . . | 10 | 46 | 0 | 121 | 13 | 0 |
| Rottee I., S.W. Point | 11 | 2 | 0 | 122 | 55 | 0 |
| — Booca Bay . . . | 10 | 56 | 0 | 123 | 10 | 0 |
| Cartier's Island . . | 12 | 29 | 0 | 123 | 56 | 0 |
| Heywood's N. Reef . | 12 | 48 | 0 | 124 | 25 | 0 |
| — South Reef . . . | 13 | 29 | 0 | 124 | 5 | 0 |
| Hibernia Shoal . . | 11 | 56 | 0 | 123 | 28 | 0 |
| Ashmore's Shoal, | | | | | | |
| — North East end . | 12 | 11 | 0 | 122 | 58 | 30 |
| Scott's Reef, N.W.end | 13 | 52 | 30 | 121 | 59 | 0 |
| Rowley's Shoals, | | | | | | |
| — Imperieuse, E. end | 17 | 35 | 0 | 118 | 51 | 0 |
| — Clerke's, S. end . | 17 | 28 | 0 | 119 | 18 | 0 |
| — Mermaid's . . . | 17 | 12 | 0 | 119 | 35 | 0 |
| Ritchie's Reef . . . | 20 | 17 | 40 | 114 | 46 | 6 |
| Timor I., S. W. Point | 10 | 23 | 0 | 123 | 30 | 0 |
| — Copang, Fort . . | 10 | 8 | 30 | 123 | 35 | 0 |
| *Var.* 0° 37′ *E.* | | | | | | |
| — North West Point | 9 | 24 | 0 | 123 | 55 | 0 |
| — Batagoda . . . | 8 | 57 | 30 | 124 | 55 | 0 |
| — Dellie . . . . | 8 | 35 | 30 | 125 | 40 | 0 |
| — East Point . . . | 8 | 21 | 0 | 127 | 15 | 0 |
| Pulo Jackee . . . | 8 | 19 | 0 | 127 | 18 | 0 |
| Pulo Battoo . . . | 9 | 16 | 0 | 124 | 5 | 0 |
| Pulo Cambing, S. Pt. | 8 | 21 | 0 | 125 | 39 | 0 |
| Pulo Babye . . . . | 8 | 5 | 0 | 125 | 49 | 0 |
| Dog Island . . . . | 7 | 41 | 0 | 126 | 3 | 0 |
| Wetter I., E. Point . | 7 | 46 | 0 | 126 | 54 | 0 |
| Kisse Island . . . | 8 | 0 | 0 | 127 | 7 | 0 |
| Roma, W. end . . . | 7 | 36 | 0 | 127 | 21 | 0 |
| Pulo Damma . . . | 7 | 20 | 0 | 128 | 36 | 0 |
| Serwatty Islands, | | | | | | |
| — Lettee I., W. Pt. . | 8 | 16 | 0 | 127 | 46 | 0 |
| — Ceremata, S.E. Pt. | 8 | 19 | 0 | 129 | 0 | 0 |
| Cerowa . . . . . | 6 | 10 | 0 | 130 | 5 | 0 |
| Babber . . . . . | 8 | 8 | 0 | 129 | 40 | 0 |
| Timor Laut, S. Point | 8 | 27 | 0 | 130 | 50 | 0 |
| Arroe Is., S. end . . | 7 | 0 | 0 | 133 | 56 | 0 |
| Banda Islands . . . | 4 | 31 | 0 | 130 | 0 | 0 |
| Turtle Is., E. end . . | 5 | 25 | 0 | 127 | 38 | 0 |
| Lucepara Islands . . | 5 | 40 | 0 | 127 | 21 | 0 |
| Goonong Apy or | | | | | | |
| Burning Island . . | 6 | 35 | 0 | 126 | 40 | 0 |
| Bouro I., N.W. Point | 3 | 6 | 0 | 125 | 57 | 0 |
| — CajeliBay, N.E.Pt. | 3 | 15 | 0 | 127 | 5 | 0 |
| — Fort . . . . . | 3 | 24 | 0 | 127 | 4 | 0 |
| Amblau Island . . . | 3 | 52 | 0 | 127 | 14 | 0 |
| Pulo Manipa, mid. . | 3 | 17 | 0 | 127 | 28 | 0 |
| Bonoa Island . . . | 3 | 0 | 0 | 127 | 56 | 0 |

*Eastern Passages to China.*

*Banda Sea.*

| (60) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Amboyna Island, | | | | | | |
| — Fort Victoria . . | 3 | 40 | 0 | 128 | 15 | 0 |
| Noesa Laut . . . . | 3 | 40 | 0 | 128 | 52 | 30 |
| Ceram I., S.W. Point | 3 | 31 | 0 | 127 | 56 | 0 |
| — Sawa Bay . . . | 2 | 51 | 0 | 129 | 6 | 0 |
| — Flat Point . . . | 2 | 53 | 0 | 129 | 42 | 30 |
| — Waroo Bay . . . | 3 | 25 | 0 | 130 | 40 | 0 |
| Kessing I., E. Point . | 3 | 55 | 0 | 131 | 10 | 0 |
| Ceram Laut, W. end | 3 | 56 | 0 | 131 | 19 | 0 |
| Goram Island . . . | 4 | 0 | 0 | 131 | 44 | 0 |
| Mattabella Islands . | 4 | 21 | 0 | 131 | 52 | 0 |
| Leeuwaarden Island . | 3 | 20 | 0 | 130 | 58 | 0 |
| Leeuwaarden Shoal . | 2 | 56 | 0 | 130 | 43 | 30 |
| Xulla Islands, | | | | | | |
| — Albion Island . . | 1 | 40 | 0 | 124 | 26 | 0 |
| — Skelton's Island . | 1 | 40 | 0 | 124 | 36 | 0 |
| — Xulla Talaybo, | | | | | | |
| S.W. end . . . . | 1 | 55 | 0 | 124 | 40 | 0 |
| — Xulla Mangola, | | | | | | |
| S. E. end . . . . | 1 | 46 | 0 | 126 | 17 | 0 |
| — Lissamatula, | | | | | | |
| S. E. Point . . . | 1 | 46 | 0 | 126 | 32 | 0 |
| — Xulla Bessey, | | | | | | |
| N.W. Point . . . | 1 | 58 | 0 | 125 | 48 | 0 |
| South East Point . | 2 | 28 | 0 | 125 | 58 | 0 |
| Gomona Island . . | 1 | 56 | 0 | 127 | 38 | 0 |
| Oby Major, W. end . | 1 | 32 | 0 | 127 | 12 | 0 |
| Lookisong, S. end . . | 1 | 45 | 0 | 128 | 10 | 0 |
| Pulo Gasses, S. Point | 1 | 41 | 0 | 128 | 20 | 0 |
| Kekik Island . . . | 1 | 33 | 0 | 128 | 37 | 30 |
| Pulo Pisang . . . | 1 | 23 | 0 | 128 | 53 | 0 |
| Boo Islands . . . . | 1 | 12 | 0 | 129 | 18 | 0 |
| Grand Kanary . . . | 1 | 44 | 0 | 129 | 40 | 0 |
| Mysole, W. end . . | 1 | 54 | 0 | 129 | 46 | 0 |
| Pulo Popa, S.E. Point | 1 | 12 | 0 | 129 | 52 | 0 |
| PuloBattanta, C. Mabo | 0 | 56 | 0 | 130 | 25 | 0 |
| Salawatty I., W. end | 1 | 2 | 0 | 130 | 46 | 0 |
| Pigeon Island . . . | 0 | 37 | 0 | 130 | 51 | 0 |
| Augusta Island . . | 0 | 36 | 0 | 130 | 48 | 0 |
| K. William's I., W.end | 0 | 28 | 0 | 130 | 44 | 0 |
| Amsterdam I. . . . | 0 | 19 | 30 | 132 | 15 | 0 |
| Waygeou I., S.W. Pt. | 0 | 16 | 0 | 130 | 19 | 0 |
| — Point Pigot . . | 0 | 21 | 0 | 131 | 18 | 0 |
| — Foul Island . . . | 0 | 43 | 0 | 131 | 0 | 0 |
| — Offak, Harbour . | 0 | 0 | 0 | 130 | 50 | 0 |
| Gagy Island . . . | 0 | 25 | 0 | 130 | 0 | 0 |
| | North | | | | | |
| Geby, I., N.W. Point | 0 | 4 | 0 | 129 | 19 | 0 |
| Syang Island . . . | 0 | 22 | 0 | 129 | 55 | 0 |
| Eye Island . . . . | 0 | 24 | 0 | 129 | 53 | 0 |
| Ormsbee's Shoal . . | 0 | 42 | 0 | 130 | 4 | 0 |
| Youl or Aiou Islands, | | | | | | |
| — Aiou Baba . . . | 0 | 25 | 0 | 131 | 0 | 0 |
| — N.W. Island . . | 0 | 38 | 0 | 131 | 8 | 0 |
| — N. end of Shoal . | 0 | 41 | 0 | 131 | 8 | 0 |
| — N. E. Island . . | 0 | 36 | 0 | 131 | 15 | 0 |
| Asia's Is., S. end . . | 1 | 0 | 0 | 131 | 17 | 0 |
| | South | | | | | |
| Gillolo I., S. end . . | 0 | 48 | 0 | 128 | 28 | 0 |
| — Point Samolin . . | 0 | 11 | 0 | 127 | 45 | 0 |
| | North | | | | | |
| — North Point . . | 2 | 23 | 0 | 127 | 45 | 30 |

*Pitts Passage.*

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## LATITUDES AND LONGITUDES.

| (61) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Molucca Islands.* | | | | | | |
| Gillolo I., Ossa | 0 | 45 | 0 | 128 | 22 | 0 |
| Pulo Moar | 0 | 9 | 0 | 128 | 58 | 0 |
| Canton's Shoal | 0 | 35 | 0 | 128 | 55 | 0 |
| Catharine's Islands | 0 | 39 | 0 | 129 | 11 | 0 |
| Aurora Shoal | 0 | 40 | 0 | 129 | 30 | 0 |
| Ardasier's Rock | 0 | 45 | 0 | 129 | 8 | 0 |
| Morty Island, N. end | 2 | 44 | 0 | 128 | 25 | 0 |
| — South end | 1 | 48 | 0 | 128 | 26 | 0 |
| Ternate Island, Road | 0 | 49 | 0 | 127 | 30 | 0 |
| Tidore I, N. E. end | 0 | 46 | 0 | 127 | 24 | 30 |
| — South end | 0 | 34 | 0 | 127 | 24 | 30 |
| Kayo Island, N. end | 0 | 7 | 0 | 127 | 23 | 30 |
| The Wolf | 0 | 20 | 0 | 127 | 6 | 0 |
| | South | | | | | |
| Amsterdam Island | 0 | 20 | 30 | 127 | 53 | 30 |
| Batchian Island, | | | | | | |
| — Heneker Point | 0 | 48 | 0 | 128 | 3 | 0 |
| — Fort Barnevelt | 0 | 32 | 0 | 127 | 44 | 0 |
| | North | | | | | |
| Tyfore Island | 0 | 58 | 0 | 126 | 27 | 0 |
| Meyo Island | 1 | 12 | 0 | 126 | 39 | 0 |
| Meangis Islands | 5 | 0 | 0 | 127 | 45 | 0 |
| Salibaboo Islands, | | | | | | |
| — Karkalang, N. Pt. | 4 | 27 | 0 | 127 | 6 | 0 |
| South Point | 4 | 0 | 0 | 127 | 5 | 0 |
| — Kabroang, S. end | 3 | 47 | 0 | 127 | 11 | 0 |
| Northumberland Sh. | 3 | 39 | 0 | 127 | 14 | 0 |
| Sangir I., N. Point | 3 | 46 | 0 | 125 | 41 | 0 |
| — River | 3 | 28 | 0 | 125 | 44 | 0 |
| — South East Point | 3 | 21 | 0 | 125 | 48 | 0 |
| Siao Island | 2 | 43 | 0 | 125 | 35 | 30 |
| Tagolanda Island | 2 | 23 | 0 | 125 | 36 | 0 |
| Bejaren Island | 2 | 6 | 0 | 125 | 30 | 0 |
| Banka Island | 1 | 52 | 0 | 125 | 24 | 0 |
| Monado, Fort | 1 | 28 | 0 | 124 | 48 | 0 |
| Cape Coffin | 1 | 44 | 0 | 125 | 22 | 0 |
| Kemar | 1 | 22 | 0 | 125 | 19 | 0 |
| Goonoong Tella River | 0 | 28 | 30 | 123 | 15 | 0 |
| | South | | | | | |
| *Celebes Island.* Cape Talabo | 0 | 48 | 0 | 123 | 51 | 0 |
| Point Lassoa | 5 | 34 | 0 | 120 | 28 | 0 |
| Laycan Point | 5 | 37 | 0 | 119 | 33 | 30 |
| Macassar, Castle | 5 | 9 | 0 | 119 | 36 | 0 |
| Cape Mandhar | 3 | 35 | 0 | 119 | 9 | 0 |
| Cape William | 2 | 34 | 0 | 118 | 58 | 0 |
| | North | | | | | |
| CapeTemoel, N.W.Pt. | 0 | 1 | 0 | 119 | 26 | 0 |
| North Watcher | 0 | 33 | 0 | 119 | 34 | 0 |
| Point Donda | 0 | 48 | 0 | 119 | 57 | 0 |
| Cape Rivers | 1 | 15 | 0 | 120 | 34 | 0 |
| | South | | | | | |
| Waxway Island | 3 | 34 | 0 | 123 | 14 | 0 |
| Weycoongy I., mid. | 4 | 3 | 0 | 123 | 8 | 0 |
| Bouton I., N. E. Pt. | 4 | 23 | 0 | 123 | 4 | 0 |
| — Calansoesoe Bay | 4 | 55 | 0 | 123 | 11 | 0 |
| — East Point | 5 | 15 | 0 | 123 | 15 | 0 |
| — South Point | 5 | 42 | 0 | 122 | 44 | 0 |
| — Bouton, Town | 5 | 27 | 0 | 122 | 40 | 0 |
| Cambyna, Peak | 5 | 21 | 0 | 121 | 57 | 0 |
| South Island | 5 | 40 | 0 | 122 | 30 | 0 |
| Hagedis Island | 6 | 13 | 0 | 122 | 40 | 0 |

| (62) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Strait of Macassar.* Token Besseys Is., | | | | | | |
| — Wangiwange, | | | | | | |
| North end | 5 | 15 | 30 | 123 | 33 | 0 |
| — Pirocko, S. end | 6 | 14 | 0 | 124 | 1 | 0 |
| St. Matthew's Is. mid | 5 | 18 | 0 | 124 | 16 | 0 |
| Velthoen's Island | 5 | 58 | 0 | 124 | 48 | 0 |
| Angelica Shoal | 7 | 40 | 0 | 122 | 18 | 0 |
| Rusa Linguete | 8 | 5 | 0 | 122 | 0 | 0 |
| Rusa Raji | 8 | 17 | 0 | 121 | 38 | 0 |
| Bangalore Shoal | 7 | 40 | 0 | 121 | 46 | 0 |
| Kalatoa Island | 7 | 12 | 0 | 121 | 43 | 0 |
| S. E. Schiedam | 7 | 12 | 0 | 120 | 56 | 0 |
| N. W. Schiedam | 7 | 1 | 0 | 120 | 28 | 0 |
| Salayer I., S. Point | 6 | 24 | 0 | 120 | 35 | 0 |
| — North Point | 5 | 49 | 0 | 120 | 30 | 0 |
| South Island | 5 | 46 | 0 | 120 | 29 | 0 |
| Middle Island | 5 | 40 | 0 | 120 | 28 | 0 |
| North Island | 5 | 37 | 0 | 120 | 24 | 0 |
| Mansfield Shoal | 5 | 45 | 0 | 120 | 13 | 30 |
| *Celebesian Archipelago.* The Brill, S. end | 6 | 5 | 0 | 119 | 0 | 0 |
| Tanataki Island | 5 | 34 | 0 | 119 | 24 | 0 |
| Tonyn Is., S. W. end | 5 | 31 | 0 | 118 | 36 | 0 |
| De Laars or Boot, | | | | | | |
| — South East end | 5 | 53 | 0 | 118 | 26 | 0 |
| Zalinoff Island | 5 | 31 | 0 | 118 | 25 | 0 |
| Hen and Chickens | 5 | 28 | 0 | 117 | 54 | 0 |
| Amsterdam Island | 5 | 15 | 0 | 117 | 54 | 0 |
| Rotterdam Island | 5 | 10 | 0 | 117 | 56 | 0 |
| Middleburg Island | 5 | 5 | 0 | 117 | 57 | 0 |
| Sibbald's Bank | 5 | 46 | 0 | 117 | 15 | 0 |
| Noesa Comba | 5 | 15 | 0 | 117 | 9 | 0 |
| Noesa Seros | 5 | 2 | 0 | 117 | 9 | 0 |
| Little Pulo Laut Is., | | | | | | |
| — South end | 5 | 0 | 0 | 115 | 47 | 0 |
| Moresses | 4 | 25 | 0 | 116 | 3 | 0 |
| Dwalder | 4 | 12 | 0 | 116 | 21 | 0 |
| Royal George Shoal | 4 | 10 | 30 | 116 | 34 | 0 |
| Two Brothers | 4 | 26 | 0 | 116 | 32 | 0 |
| Waller's Shoal, S. end | 4 | 37 | 0 | 117 | 7 | 0 |
| Laurel Shoal | 4 | 32 | 0 | 117 | 15 | 0 |
| Pulo Laut, S. Point | 4 | 4 | 0 | 116 | 22 | 0 |
| — North East Point | 3 | 23 | 0 | 116 | 41 | 0 |
| — North Point | 3 | 13 | 0 | 116 | 30 | 0 |
| Three Alike | 3 | 41 | 0 | 116 | 54 | 0 |
| Dutch Triangles | 3 | 1 | 0 | 117 | 53 | 0 |
| Addington's Shoal | 2 | 50 | 0 | 117 | 0 | 0 |
| Little Paternosters, | | | | | | |
| — South Island | 2 | 50 | 0 | 117 | 40 | 0 |
| — North East Island | 2 | 10 | 0 | 117 | 58 | 0 |
| — North West Island | 2 | 8 | 0 | 117 | 42 | 0 |
| | North | | | | | |
| North Watcher | 0 | 33 | 0 | 119 | 34 | 0 |
| *Island of Borneo.* North Point | 7 | 3 | 0 | 116 | 43 | 0 |
| Sandakan Bay, | | | | | | |
| — Babalatoli Island | 5 | 54 | 0 | 118 | 6 | 0 |
| Unsang Point | 5 | 19 | 0 | 119 | 0 | 0 |
| Kaneeoongan Point | 1 | 5 | 0 | 119 | 10 | 0 |
| | South | | | | | |
| Dondrekin I., S. Pt. | 0 | 54 | 0 | 117 | 36 | 0 |
| Passeer River, entr. | 1 | 54 | 0 | 116 | 34 | 0 |
| Ragged Point | 2 | 10 | 0 | 116 | 48 | 0 |

## LATITUDES AND LONGITUDES.

| (63) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Island of Borneo.* | | | | | | |
| Shoal Point | 2 | 35 | 0 | 116 | 47 | 0 |
| Point Salatan | 4 | 10 | 0 | 114 | 42 | 0 |
| Benjar River, entr. | 3 | 25 | 0 | 114 | 38 | 0 |
| Flat Point | 3 | 31 | 0 | 112 | 8 | 0 |
| Pulo Mancap | 3 | 4 | 45 | 110 | 11 | 30 |
| Mancap Shoals, S. end | 3 | 22 | 0 | 110 | 8 | 0 |
| Rendezvous I., W. end | 2 | 44 | 0 | 110 | 3 | 0 |
| Minto Hill | 2 | 15 | 0 | 110 | 6 | 0 |
| Succadana | 1 | 16 | 0 | 109 | 58 | 0 |
| | North | | | | | |
| Pontiana River, entr. | 0 | 2 | 0 | 109 | 12 | 0 |
| Marapava Point | 0 | 17 | 30 | 109 | 0 | 0 |
| Sambas River, entr. | 1 | 13 | 30 | 109 | 3 | 0 |
| Tanjong Apee | 1 | 57 | 0 | 109 | 14 | 0 |
| Tanjong Dattoo | 3 | 0 | 0 | 110 | 46 | 0 |
| Borneo | 4 | 55 | 0 | 114 | 55 | 0 |
| Pulo Tiega | 5 | 38 | 0 | 115 | 16 | 0 |
| Ahai | 6 | 21 | 0 | 116 | 24 | 0 |
| Keeney Balloo, Mount | 6 | 3 | 0 | 116 | 40 | 0 |
| *Sooloo Islands.* | | | | | | |
| Banguey, Peak | 7 | 19 | 0 | 117 | 6 | 0 |
| Balambangan Island, | | | | | | |
| — North Harbour | 7 | 16 | 0 | 116 | 58 | 0 |
| Mangsee Islands | 7 | 32 | 0 | 117 | 19 | 0 |
| Balabac, Peak | 7 | 59 | 0 | 117 | 2 | 0 |
| St. Michael's Bank, | | | | | | |
| — North end | 7 | 50 | 0 | 118 | 20 | 0 |
| Cagayan Sooloo | 7 | 0 | 0 | 118 | 36 | 0 |
| Palawan, S.W. Point | 8 | 24 | 0 | 117 | 14 | 0 |
| — Long Point | 9 | 39 | 0 | 118 | 21 | 45 |
| — Ooloogan Point | 10 | 12 | 0 | 118 | 55 | 0 |
| — North Point | 11 | 30 | 0 | 119 | 37 | 0 |
| Ragged Islands | 11 | 15 | 0 | 119 | 21 | 0 |
| York Breakers | 9 | 54 | 0 | 118 | 12 | 0 |
| Paraquas | 9 | 10 | 0 | 117 | 32 | 0 |
| *Philippine Islands.* | | | | | | |
| Sooloo, Town | 6 | 1 | 0 | 121 | 12 | 0 |
| Pangootaran | 6 | 15 | 0 | 120 | 40 | 0 |
| Belawn, E. Point | 6 | 0 | 0 | 122 | 8 | 0 |
| Tapeantana, S. E. Pt. | 6 | 14 | 30 | 122 | 8 | 0 |
| Tamook | 6 | 28 | 0 | 121 | 56 | 0 |
| Mataha | 6 | 32 | 0 | 121 | 50 | 0 |
| Sangboye | 6 | 48 | 30 | 121 | 35 | 0 |
| Teynga | 6 | 52 | 0 | 121 | 43 | 0 |
| Ballook, N. end | 6 | 40 | 0 | 121 | 50 | 0 |
| Basseelan, E. Point | 6 | 30 | 0 | 122 | 30 | 0 |
| *Philippine Islands.* | | | | | | |
| Mindanao Island, | | | | | | |
| — Samboangan | 6 | 53 | 0 | 122 | 14 | 0 |
| — Port St. Maria | 7 | 36 | 0 | 122 | 16 | 0 |
| — Balangonan Point | 7 | 51 | 0 | 122 | 24 | 0 |
| — North Point | 9 | 48 | 0 | 126 | 20 | 0 |
| — Surigao, Village | 9 | 47 | 0 | 125 | 25 | 0 |
| — Cape St. Augustine | 6 | 4 | 0 | 126 | 48 | 0 |
| — South Point | 5 | 39 | 0 | 125 | 7 | 0 |
| — Mindanao, Town | 7 | 10 | 0 | 124 | 35 | 0 |
| Sarangani I., S. Point | 5 | 20 | 0 | 125 | 43 | 0 |
| Hummock I., Peak | 5 | 22 | 0 | 125 | 32 | 0 |
| Samar Island, | | | | | | |
| — C.St.EspiritoSanto | 12 | 40 | 0 | 125 | 38 | 0 |
| St. Bernardino Island | 12 | 46 | 0 | 124 | 16 | 0 |
| Cagayanes Is., mid. | 9 | 34 | 0 | 121 | 23 | 30 |

| (64) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Philippine Islands.* | | | | | | |
| Negros Island, | | | | | | |
| — Point Sojoton | 9 | 50 | 0 | 122 | 24 | 0 |
| Panay Island, | | | | | | |
| — Point Nasog | 10 | 25 | 0 | 122 | 6 | 0 |
| — Astoman | 10 | 32 | 0 | 122 | 4 | 0 |
| — Point Potol | 11 | 48 | 0 | 123 | 0 | 0 |
| White Rock | 10 | 28 | 0 | 121 | 15 | 0 |
| Sombrero Rock | 10 | 45 | 0 | 121 | 38 | 0 |
| Cuyo Island | 10 | 52 | 0 | 121 | 16 | 0 |
| Dry Bank | 11 | 24 | 30 | 121 | 54 | 0 |
| Quimluban Islands, | | | | | | |
| — North End | 11 | 28 | 0 | 121 | 11 | 0 |
| Caravaos | 11 | 53 | 0 | 121 | 48 | 0 |
| Green Island | 12 | 3 | 0 | 119 | 49 | 15 |
| Calamianes, Rock | 11 | 56 | 15 | 119 | 51 | 30 |
| N.W. Rock | 12 | 23 | 15 | 119 | 54 | 45 |
| North Rock | 12 | 27 | 0 | 120 | 4 | 15 |
| Calavite | 12 | 21 | 0 | 119 | 56 | 30 |
| Appo Shoal, N. end | 12 | 45 | 0 | 120 | 31 | 0 |
| — Great Island | 12 | 39 | 0 | 120 | 28 | 0 |
| Ambolon, S. end | 12 | 9 | 0 | 121 | 15 | 0 |
| Mindoro Island, | | | | | | |
| — Pandan Point | 12 | 48 | 0 | 120 | 52 | 0 |
| — River Musi | 13 | 14 | 0 | 120 | 44 | 0 |
| — Point Tubili | 13 | 20 | 0 | 120 | 34 | 0 |
| — Point Calavite | 13 | 27 | 0 | 120 | 20 | 0 |
| Luban Island, mid. | 13 | 44 | 0 | 120 | 16 | 0 |
| Goat Island | 13 | 51 | 0 | 120 | 7 | 0 |
| Luconia or Luzon I., | | | | | | |
| — Cavite | 14 | 29 | 0 | 121 | 0 | 0 |
| — Manilla, City | 14 | 36 | 0 | 121 | 2 | 30 |
| *Var.* 0° 17′ *E.* | | | | | | |
| — Subic Bay, entr. | 14 | 46 | 0 | 120 | 16 | 0 |
| — Silanguin Bay | 14 | 47 | 0 | 120 | 7 | 0 |
| — Point Capones | 14 | 52 | 30 | 120 | 3 | 30 |
| — Sisters | 15 | 50 | 0 | 119 | 50 | 0 |
| — Adder's Island | 15 | 55 | 0 | 119 | 49 | 0 |
| — Point Bolinao | 16 | 26 | 0 | 119 | 52 | 0 |
| — Cape Bajadore | 18 | 32 | 0 | 120 | 39 | 0 |
| — Cape Engano | 18 | 39 | 0 | 122 | 16 | 0 |
| — Cape St. Ildifonso | 15 | 47 | 0 | 122 | 7 | 0 |
| — Sorsogan | 12 | 52 | 20 | 123 | 50 | 0 |
| Ticoa Island, | | | | | | |
| — Port St. Jacinto | 12 | 34 | 0 | 123 | 42 | 0 |
| Catanduanes Island, | | | | | | |
| — North Point | 14 | 16 | 0 | 124 | 30 | 0 |
| — South Point | 13 | 38 | 0 | 124 | 16 | 0 |
| Babuyan Islands, | | | | | | |
| — Camaguin | 19 | 4 | 0 | 121 | 52 | 0 |
| — Fuga | 19 | 1 | 0 | 121 | 21 | 0 |
| — Lapurip | 19 | 15 | 0 | 121 | 12 | 0 |
| — Calayan | 19 | 28 | 0 | 121 | 25 | 0 |
| — Claro Babuyan | 19 | 37 | 0 | 121 | 54 | 0 |
| Bashee Islands, | | | | | | |
| — Balintang | 19 | 58 | 0 | 122 | 14 | 0 |
| — Batan, Mount | 20 | 23 | 30 | 122 | 11 | 0 |
| — Grafton | 20 | 34 | 30 | 122 | 4 | 0 |
| — North Bashee | 21 | 9 | 0 | 122 | 0 | 0 |
| Gadd's Reef | 21 | 43 | 0 | 121 | 41 | 0 |
| Botel Tobago Xima | 21 | 59 | 0 | 121 | 38 | 0 |
| Little Botel | 21 | 56 | 30 | 121 | 41 | 0 |

## LATITUDES AND LONGITUDES.

| (65) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Vele Rete Rocks | 21 | 42 | 0 | 120 | 52 | 0 |
| Formosa I., S. Point | 21 | 54 | 0 | 120 | 55 | 0 |
| — Lamay Island | 22 | 19 | 15 | 120 | 27 | 0 |
| — North Point | 25 | 18 | 0 | 121 | 34 | 0 |
| — N.W. Point | 25 | 11 | 0 | 121 | 6 | 0 |
| — N.E. Point | 25 | 11 | 0 | 121 | 56 | 0 |

### XVIII. Islands, Rocks, and Shoals, in the CHINA SEA.

* For the Islands, &c. at the entrance to the China Sea, see Columns (56) and (57).

| | | | | | | |
|---|---|---|---|---|---|---|
| Pulo Brala | 4 | 47 | 0 | 103 | 37 | 0 |
| Pulo Capas | 5 | 15 | 0 | 103 | 14 | 0 |
| Great Redang Island | 5 | 53 | 0 | 102 | 55 | 0 |
| Pulo Cara | 8 | 29 | 0 | 100 | 56 | 0 |
| Pulo Way | 9 | 55 | 0 | 103 | 25 | 0 |
| Pulo Oby | 8 | 25 | 0 | 104 | 54 | 0 |
| Brothers | 8 | 35 | 0 | 106 | 8 | 0 |
| Pulo Condore, mid. | 8 | 40 | 0 | 106 | 42 | 0 |
| Pulo Sapata | 10 | 0 | 0 | 109 | 2 | 30 |
| Great Catwick | 10 | 6 | 0 | 108 | 52 | 0 |
| Royal Bishop's Shoal, — South end | 9 | 40 | 0 | 108 | 21 | 30 |
| Charlotte's Shoal | 7 | 11 | 0 | 107 | 36 | 0 |
| Pulo Ceicer de Mer | 10 | 32 | 30 | 108 | 53 | 0 |
| Holland's Bank, S. end | 10 | 37 | 15 | 108 | 40 | 0 |
| Britto's Bank | 10 | 30 | 42 | 107 | 49 | 0 |
| Minerva's Bank | 10 | 38 | 0 | 110 | 18 | 0 |
| Prince of Wales' Bank, — South West end | 8 | 3 | 0 | 110 | 24 | 0 |
| — North East end | 8 | 13 | 0 | 110 | 34 | 0 |
| West London Reef | 8 | 55 | 0 | 112 | 0 | 0 |
| East London Reef | 8 | 48 | 0 | 112 | 24 | 0 |
| Dhaulle's Shoal | 9 | 32 | 0 | 112 | 25 | 0 |
| Stags, North end | 8 | 24 | 0 | 112 | 57 | 0 |
| Amboina Shoal | 7 | 52 | 20 | 112 | 56 | 0 |
| Swallow Shoal | 7 | 23 | 30 | 113 | 52 | 0 |
| Royal Charlotte Shoal | 6 | 56 | 30 | 113 | 37 | 30 |
| Louisa's Shoal | 6 | 20 | 0 | 113 | 18 | 0 |
| Friendship's Sh. N. end | 6 | 0 | 0 | 112 | 49 | 0 |
| Sea Horse Breakers | 5 | 35 | 0 | 112 | 28 | 0 |
| Investigator's N.W. Sh | 9 | 40 | 0 | 113 | 4 | 0 |
| Western Reef | 10 | 15 | 0 | 113 | 41 | 0 |
| Great Reef., N. end | 10 | 7 | 0 | 113 | 52 | 0 |
| South Island | 10 | 45 | 0 | 114 | 27 | 0 |
| North West Island | 11 | 9 | 0 | 114 | 18 | 0 |
| North Danger | 11 | 29 | 0 | 114 | 20 | 0 |
| Investigator's Shoal, — West end | 8 | 5 | 0 | 114 | 35 | 0 |
| — East End | 8 | 10 | 0 | 114 | 51 | 0 |
| Viper's Shoal | 8 | 0 | 0 | 115 | 25 | 0 |
| Half Moon Shoal, S. end | 8 | 54 | 30 | 116 | 15 | 30 |
| Royal Captain's Shoal | 9 | 2 | 24 | 116 | 42 | 45 |
| Bombay's Shoal | 9 | 27 | 0 | 116 | 55 | 0 |
| Investigator's N.E. Sh. | 9 | 13 | 0 | 116 | 30 | 0 |
| Sea Horse Bank | 10 | 51 | 0 | 117 | 55 | 30 |
| Scarborough Shoal, mid | 15 | 8 | 0 | 117 | 48 | 30 |
| Macclesfield's Bank, — North end | 16 | 19 | 0 | 114 | 36 | 0 |

| (66) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| — South end | 15 | 17 | 0 | 114 | 10 | 0 |
| St. Esprit's Shoal | 19 | 30 | 0 | 113 | 6 | 0 |
| Pratas, N. E. end | 20 | 47 | 0 | 116 | 53 | 45 |
| — N.W. end | 20 | 45 | 0 | 116 | 42 | 15 |
| North Shoal, W. end | 17 | 4 | 30 | 111 | 27 | 0 |
| — East end | 17 | 6 | 10 | 111 | 32 | 30 |
| Amphitrite, W. end | 16 | 59 | 0 | 112 | 12 | 0 |
| — East end | 16 | 54 | 0 | 112 | 23 | 0 |
| Woody Island | 16 | 50 | 0 | 112 | 19 | 0 |
| Rocky Island | 16 | 52 | 0 | 112 | 20 | 0 |
| Lincoln Island | 16 | 41 | 0 | 112 | 42 | 0 |
| Pyramid Rock | 16 | 35 | 15 | 112 | 37 | 30 |
| Money's Island | 16 | 28 | 0 | 111 | 29 | 30 |
| Robert's Island | 16 | 31 | 50 | 111 | 34 | 30 |
| Pattle's Island | 16 | 33 | 20 | 111 | 36 | 0 |
| Observation Bank | 16 | 36 | 0 | 111 | 40 | 30 |
| Drummond's Island | 16 | 29 | 10 | 111 | 43 | 37 |
| Gov. Duncan's Island | 16 | 28 | 40 | 111 | 41 | 0 |
| Discovery's Shoal, — West end | 16 | 11 | 0 | 111 | 32 | 30 |
| — East end | 16 | 16 | 0 | 111 | 46 | 30 |
| Vadalore's Shoal, — West end | 16 | 17 | 30 | 111 | 58 | 30 |
| — East end | 16 | 19 | 30 | 112 | 4 | 45 |
| Bombay Shoal | 16 | 0 | 0 | 112 | 26 | 0 |
| Passoo Keah Island | 16 | 2 | 0 | 111 | 45 | 0 |
| Triton Island | 15 | 46 | 40 | 111 | 11 | 30 |

*Paracels.*

### XIX. The Coast and adjacent Islands from CANTON to CAPE NORTH.

| | | | | | | |
|---|---|---|---|---|---|---|
| Canton, Factory | 23 | 7 | 10 | 113 | 14 | 0 |
| Macao, Town | 22 | 10 | 30 | 113 | 32 | 0 |
| Grand Ladrone | 21 | 57 | 10 | 113 | 44 | 0 |
| Po-toe | 22 | 2 | 6 | 113 | 38 | 0 |
| Chung Chow | 22 | 10 | 15 | 113 | 43 | 50 |
| Laff-Sammee, Peak | 22 | 8 | 30 | 113 | 48 | 40 |
| Lantao or Ty-ho, — S.W. Point | 22 | 12 | 0 | 113 | 50 | 0 |
| — N.E. Point | 22 | 21 | 0 | 114 | 2 | 35 |
| — Highest Peak | 22 | 15 | 15 | 113 | 54 | 15 |
| I-Chow | 22 | 3 | 0 | 113 | 54 | 45 |
| Asses Ears or Ky-poong | 21 | 54 | 0 | 114 | 1 | 0 |
| Grand Lema, N.E. end | 22 | 4 | 45 | 114 | 18 | 30 |
| Lin-ting | 22 | 6 | 0 | 114 | 1 | 30 |
| Hong-kong Island, — Tytam Bay, S.W. Pt. | 22 | 12 | 30 | 114 | 12 | 40 |
| Waylan Island | 22 | 11 | 44 | 114 | 17 | 50 |
| Nine Pin Rock | 22 | 16 | 30 | 114 | 22 | 0 |
| Mirs Bay, S. E. Point | 22 | 27 | 15 | 114 | 30 | 0 |
| Chueng-Chow | 22 | 25 | 0 | 114 | 40 | 15 |
| Toonee-Ang | 22 | 28 | 10 | 114 | 38 | 0 |
| Mendoza Island | 22 | 31 | 22 | 114 | 50 | 45 |
| Fokay Point | 22 | 33 | 0 | 114 | 53 | 0 |
| Pedro Branco | 22 | 19 | 30 | 115 | 7 | 45 |
| Sha-long-low | 22 | 39 | 30 | 115 | 35 | 30 |
| Teng-mee | 22 | 45 | 0 | 115 | 50 | 0 |
| Cup-chee-san | 22 | 49 | 30 | 116 | 7 | 30 |
| Black Mount | 22 | 52 | 30 | 116 | 11 | 0 |
| Breaker Point | 22 | 56 | 45 | 116 | 31 | 30 |

## LATITUDES AND LONGITUDES.

| (67) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Eastern Coast of China. | | | | | | |
| Cape of Good Hope | 33 | 13 | 45 | 116 | 50 | 0 |
| Namoa Island, W. Pt. | 23 | 28 | 0 | 116 | 59 | 30 |
| — N. E. Point . . | 23 | 32 | 0 | 117 | 13 | 0 |
| Lamock Islands, S.end | 23 | 17 | 0 | 117 | 21 | 0 |
| Brothers . . . . | 23 | 32 | 0 | 117 | 48 | 0 |
| Chapel Island . . | 24 | 11 | 0 | 118 | 20 | 0 |
| Amoy Harbour, | | | | | | |
| — Caw-chat Rock | 24 | 20 | 30 | 118 | 16 | 30 |
| Chin-chew Bay, abt. | 24 | 54 | 0 | 118 | 40 | 0 |
| Lam-yet Is., S. end | 24 | 59 | 15 | 119 | 34 | 30 |
| Ting-Hoy Harbour | 26 | 10 | 0 | 119 | 57 | 0 |
| Qui-san Is., S. E. end | 29 | 22 | 0 | 122 | 11 | 54 |
| CHUSAN, City, about | 30 | 26 | 0 | 121 | 41 | 0 |
| Ningpo, City . . | 30 | 13 | 0 | 120 | 29 | 0 |
| Tchin-san Islands . | 30 | 20 | 0 | 122 | 36 | 0 |
| Yang-tse-kiang-ho | 32 | 5 | 0 | 120 | 37 | 0 |
| NANKIN . . . . | 32 | 4 | 40 | 118 | 47 | 18 |
| Whang-ho River, entr. | 34 | 3 | 0 | 120 | 0 | 0 |
| Shan-tung Promontory | | | | | | |
| — East Point . . | 37 | 23 | 40 | 122 | 45 | 0 |
| — South Point . . | 37 | 0 | 0 | 122 | 41 | 0 |
| C. Zue-oo-tow . . | 37 | 35 | 50 | 121 | 28 | 10 |
| Miatau Islands, | | | | | | |
| — Tchoosan . . | 38 | 0 | 45 | 121 | 1 | 0 |
| Keu-San Islands . | 38 | 8 | 0 | 120 | 44 | 45 |
| Pei-ho River, entr. | 38 | 51 | 30 | 117 | 49 | 0 |
| PEKIN, obs. . . . | 39 | 54 | 13 | 116 | 26 | 0 |
| Gulf of Leotong, | | | | | | |
| — S. E. or Charlotte's Point, about . . | 38 | 36 | 0 | 121 | 10 | 0 |
| Basil Hall's Islands, | | | | | | |
| — N.W. end . . . | 37 | 58 | 0 | 124 | 44 | 30 |
| Clifford's Is., middle | 36 | 44 | 0 | 125 | 50 | 0 |
| Corea, Basil's Cape | 36 | 7 | 0 | 126 | 42 | 24 |
| — S.W. Point . . | 34 | 20 | 0 | 126 | 45 | 0 |
| — Cape Providence | 34 | 24 | 0 | 127 | 14 | 0 |
| Windsor Castle I. | 34 | 40 | 0 | 126 | 6 | 0 |
| Thistle Island . . | 34 | 20 | 0 | 126 | 4 | 0 |
| Lyra Island . . . | 34 | 10 | 0 | 126 | 8 | 0 |
| High Peaked Island | 34 | 5 | 30 | 125 | 15 | 0 |
| Quelpart I., N. E. Pt. | 33 | 30 | 0 | 127 | 9 | 0 |
| — South Point . . | 33 | 11 | 0 | 126 | 28 | 30 |
| Tsus-sima I., N. Pt. | 34 | 40 | 30 | 129 | 29 | 30 |
| — South Point . . | 34 | 6 | 30 | 129 | 15 | 0 |
| Colnet's Island . . | 34 | 16 | 30 | 129 | 55 | 45 |
| Corea, Port Chusan | 35 | 2 | 0 | 129 | 15 | 30 |
| — Cape Clonard . . | 36 | 2 | 0 | 129 | 38 | 0 |
| — Sanpou . . . | 37 | 42 | 0 | 128 | 32 | 0 |
| White Rock . . . | 40 | 36 | 0 | 129 | 17 | 30 |
| Dagelet I., N. E. Pt. | 37 | 25 | 0 | 130 | 56 | 0 |
| Argonaut's Island . | 37 | 52 | 0 | 129 | 50 | 0 |
| Ternay Bay . . . | 45 | 10 | 32 | 137 | 1 | 15 |
| Suffren Bay . . . | 47 | 51 | 0 | 138 | 43 | 0 |
| Cape Lesseps . . | 49 | 30 | 0 | 140 | 34 | 0 |
| Castries Bay . . | 51 | 29 | 0 | 140 | 56 | 19 |
| Vanjuas Point . . | 52 | 5 | 0 | 141 | 32 | 0 |
| Romberg Cape . . | 53 | 26 | 30 | 141 | 44 | 45 |
| Jonas I., Peak, about | 56 | 25 | 30 | 143 | 16 | 0 |
| Ochotsk . . . . | 59 | 20 | 10 | 143 | 12 | 30 |
| Yamskoi . . . . | 60 | 46 | 0 | 154 | 30 | 0 |
| Bolcheretskoi . . | 52 | 54 | 30 | 156 | 50 | 15 |
| Cape Lopatka . . | 51 | 0 | 15 | 156 | 42 | 45 |

| (68) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Russia. | | | | | | |
| St. Peter and St. Paul | 53 | 0 | 37 | 158 | 44 | 30 |
| Kamschatka . . . | 56 | 15 | 0 | 162 | 0 | 0 |
| | | | | West | | |
| Tschukotskoi Ness . | 64 | 14 | 30 | 173 | 31 | 0 |
| East Cape . . . | 66 | 5 | 30 | 169 | 44 | 0 |
| Cape North . . . | 68 | 56 | 0 | 179 | 11 | 30 |
| | | | | East | | |
| Formosa I., S. E. Pt. | 21 | 54 | 0 | 120 | 53 | 15 |
| — South West Point | 21 | 53 | 30 | 120 | 42 | 30 |
| — Lamay Island . . | 22 | 19 | 15 | 120 | 27 | 0 |
| — Fort Zeeland . . | 23 | 3 | 0 | 120 | 22 | 0 |
| — North West Point | 25 | 11 | 0 | 121 | 6 | 0 |
| — North Point . . | 25 | 18 | 0 | 121 | 34 | 0 |
| — North East Point . | 25 | 11 | 0 | 121 | 56 | 0 |
| Pescadores Islands, | | | | | | |
| — Pehoe Island . | 23 | 32 | 0 | 119 | 33 | 0 |
| Vela Rete Rock . . | 21 | 42 | 0 | 120 | 51 | 50 |
| Gadd's Reef . . . | 21 | 43 | 0 | 121 | 41 | 0 |
| Botol Tobago Zima | 21 | 59 | 0 | 121 | 38 | 0 |
| Samo Sana . . . | 22 | 40 | 0 | 121 | 32 | 0 |
| Hospinsu Island . . | 25 | 44 | 0 | 123 | 32 | 0 |
| Tisou-su Islands . | 25 | 55 | 0 | 123 | 29 | 0 |
| Madjicosemah Is., | | | | | | |
| — Southermost . . | 24 | 6 | 0 | 123 | 52 | 0 |
| — Westernmost . . | 24 | 17 | 0 | 123 | 45 | 0 |
| — Ty-pin-san Island | 24 | 42 | 0 | 125 | 36 | 0 |
| Kumi Island . . . | 24 | 25 | 0 | 123 | 5 | 0 |
| Great Loo-choo I., | | | | | | |
| — North Point . | 26 | 52 | 0 | 128 | 6 | 30 |
| — Napakiang Road . | 26 | 13 | 30 | 127 | 38 | 30 |
| — South Point . | 26 | 5 | 0 | 127 | 33 | 0 |
| Sulphur Island . . | 27 | 52 | 0 | 128 | 22 | 0 |
| Crown Island . . . | 27 | 49 | 0 | 129 | 5 | 0 |
| Harbour Island . . | 28 | 20 | 0 | 130 | 0 | 0 |
| Bungelow Island . . | 28 | 38 | 0 | 129 | 56 | 0 |
| Pinnacle Is., | | | | | | |
| — N.W. end . . | 29 | 58 | 0 | 129 | 55 | 0 |
| Islands of Japan. | | | | | | |
| Kiusiu Island, | | | | | | |
| — Cape Nomo . . | 32 | 35 | 10 | 129 | 42 | 30 |
| — Nangasaki, City | 32 | 45 | 0 | 129 | 52 | 0 |
| — Oomoura . . . | 33 | 0 | 0 | 130 | 7 | 0 |
| — Cape Seurote . | 32 | 58 | 30 | 129 | 35 | 0 |
| — N. W. Point . | 33 | 42 | 0 | 129 | 45 | 0 |
| — Kokouro, Town | 33 | 53 | 0 | 131 | 17 | 0 |
| — North Point . . | 34 | 5 | 0 | 130 | 54 | 0 |
| — North East Point | 33 | 54 | 0 | 131 | 52 | 0 |
| — Cape Boungo . . | 33 | 18 | 0 | 132 | 6 | 0 |
| — Cape Tschirikoff | 32 | 14 | 0 | 131 | 42 | 0 |
| — Cape Cochrane . | 31 | 51 | 0 | 131 | 27 | 0 |
| — Cape Danville . | 31 | 28 | 0 | 131 | 27 | 0 |
| — Cape Nagaeff . | 31 | 15 | 0 | 131 | 11 | 0 |
| — C. Tschilschagoff | 30 | 56 | 45 | 130 | 36 | 30 |
| — Horner's Peak . | 31 | 9 | 30 | 130 | 28 | 0 |
| — Kago Simo, Town | 31 | 34 | 0 | 130 | 34 | 0 |
| — Cape Tchesme . | 31 | 24 | 0 | 130 | 2 | 0 |
| — Cape Kagul . . | 31 | 42 | 30 | 130 | 7 | 0 |
| Tanega-sima I., N.Pt. | 30 | 42 | 30 | 131 | 0 | 0 |
| Jakuno-sima I. mid. | 30 | 28 | 0 | 130 | 30 | 0 |
| Volcano Island . . | 30 | 48 | 0 | 130 | 16 | 40 |
| St. Clair Island . | 30 | 45 | 15 | 129 | 54 | 15 |
| Nadijda Rock . . | 31 | 42 | 0 | 129 | 35 | 0 |

Tartary.

Russia.

## LATITUDES AND LONGITUDES.

| (69) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Islands of Japan.* | | | | | | |
| Meac-sima Islands, | | | | | | |
| — South West end | 31 | 35 | 0 | 129 | 40 | 0 |
| — North East end | 31 | 49 | 0 | 129 | 51 | 0 |
| Asses Ears | 32 | 2 | 30 | 128 | 36 | 30 |
| Gotto Islands, | | | | | | |
| — Cape Gotto, S. Pt. | 32 | 35 | 0 | 128 | 44 | 0 |
| — North end | 33 | 34 | 0 | 129 | 10 | 0 |
| Fisando Island, Port | 33 | 39 | 0 | 129 | 36 | 0 |
| Yki Island | 33 | 56 | 0 | 129 | 48 | 0 |
| Tsus-sima I., N. Pt. | 34 | 40 | 30 | 129 | 29 | 30 |
| — South Point | 34 | 6 | 30 | 129 | 15 | 0 |
| Sikoke Island, | | | | | | |
| — Cape Yamafar | 34 | 10 | 0 | 133 | 17 | 0 |
| — Cape Misaki | 33 | 18 | 0 | 132 | 17 | 0 |
| — Cape Tosa | 32 | 25 | 0 | 133 | 17 | 0 |
| — C. Mourodino-saki | 33 | 8 | 0 | 134 | 21 | 0 |
| — Cape Ava | 33 | 52 | 0 | 135 | 0 | 0 |
| Niphon Island, | | | | | | |
| — Semonoseki, Port | 33 | 0 | 0 | 131 | 20 | 0 |
| — Faghi | 34 | 44 | 0 | 131 | 35 | 0 |
| — Famada | 35 | 12 | 0 | 132 | 13 | 0 |
| — Cape Itsoumo | 35 | 42 | 0 | 132 | 33 | 0 |
| — Tootori | 35 | 36 | 0 | 134 | 27 | 0 |
| — Point Tanga | 35 | 52 | 0 | 135 | 19 | 0 |
| — Cape Noto | 37 | 36 | 0 | 137 | 20 | 0 |
| — Cape Yetsiou | 37 | 17 | 0 | 137 | 50 | 0 |
| — Russ. Promontory | 39 | 50 | 0 | 139 | 44 | 0 |
| — Cape Gamalas | 40 | 37 | 0 | 139 | 49 | 0 |
| — Cape Greig | 41 | 9 | 16 | 140 | 8 | 0 |
| — Cape Sangar | 41 | 16 | 30 | 140 | 14 | 0 |
| — North Point | 41 | 31 | 40 | 140 | 50 | 0 |
| — N. E. Point, or Cape Nambu | 41 | 24 | 0 | 141 | 33 | 30 |
| — Port Nambu | 39 | 48 | 0 | 142 | 25 | 0 |
| — Cape Gore | 38 | 39 | 0 | 141 | 52 | 0 |
| — Cape Blanc | 35 | 13 | 0 | 140 | 40 | 0 |
| — Cape King | 34 | 54 | 0 | 140 | 19 | 0 |
| — Jeddo, Town | 35 | 40 | 0 | 139 | 50 | 0 |
| — Cape Yzou | 34 | 42 | 0 | 139 | 4 | 0 |
| — Cape Tootomy | 34 | 42 | 0 | 138 | 14 | 0 |
| — Cape Sima | 34 | 21 | 0 | 137 | 18 | 0 |
| — South Point | 33 | 25 | 0 | 135 | 47 | 0 |
| Mino-simo Island | 35 | 1 | 0 | 131 | 30 | 0 |
| Oke Island, N. Point | 36 | 30 | 0 | 133 | 17 | 0 |
| Jootsi-sima Island | 37 | 51 | 0 | 136 | 56 | 0 |
| Sado Island, N. Pt. | 39 | 4 | 0 | 138 | 20 | 0 |
| — South Point | 38 | 23 | 0 | 138 | 24 | 0 |
| Vries Island, Volcano | 34 | 40 | 0 | 139 | 32 | 0 |
| Broken Island | 34 | 21 | 0 | 139 | 37 | 0 |
| Vulcan Island | 34 | 5 | 0 | 139 | 34 | 0 |
| Princes Island | 33 | 48 | 0 | 139 | 50 | 0 |
| Broughton Rocks | 33 | 34 | 0 | 139 | 33 | 0 |
| Tatsisio Island | 33 | 6 | 0 | 140 | 0 | 0 |
| South Island | 31 | 30 | 0 | 140 | 3 | 0 |
| *Matsmay or Jesso I.* | | | | | | |
| Cape Esarme | 41 | 49 | 20 | 141 | 20 | 0 |
| Port Edermo | 42 | 19 | 30 | 141 | 7 | 30 |
| Cape Eroen | 41 | 59 | 0 | 142 | 55 | 0 |
| Bay of Good Hope, — West Point | 43 | 0 | 0 | 144 | 12 | 0 |
| Atkis Bay, entr. | 43 | 20 | 0 | 145 | 32 | 0 |
| Cape Broughton | 43 | 38 | 30 | 146 | 7 | 30 |

| (70) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Matsmay or Jesso I.* | | | | | | |
| Cape Spanberg | 44 | 35 | 0 | 145 | 0 | 0 |
| Cape Soya | 45 | 31 | 15 | 141 | 51 | 0 |
| Cape Romanzoff | 45 | 25 | 50 | 141 | 34 | 20 |
| Cape Shishkoff | 44 | 20 | 0 | 141 | 37 | 0 |
| Cape Malespina | 43 | 42 | 15 | 141 | 18 | 30 |
| C. Novosilzoff, Peak | 43 | 14 | 30 | 140 | 25 | 30 |
| C. Koutousoff, Peak | 42 | 38 | 0 | 140 | 1 | 0 |
| Cape Sineke | 41 | 39 | 30 | 139 | 54 | 15 |
| Matsumay, Town | 41 | 32 | 0 | 140 | 4 | 0 |
| Cape Nadiejeda | 41 | 25 | 10 | 140 | 9 | 30 |
| Kosima Island | 41 | 21 | 30 | 139 | 46 | 0 |
| Osima Island | 41 | 31 | 30 | 139 | 19 | 15 |
| Okosu Island | 42 | 9 | 0 | 139 | 30 | 0 |
| Pic de Langle | 45 | 11 | 0 | 141 | 12 | 15 |
| Refunchery Island, — N. E. Point | 45 | 27 | 45 | 141 | 4 | 0 |
| Monneron I., N. end | 46 | 13 | 0 | 141 | 15 | 0 |
| *Sachalin Island.* | | | | | | |
| Cape Crillon | 45 | 54 | 15 | 141 | 58 | 0 |
| Dangerous Rock | 45 | 47 | 15 | 142 | 8 | 45 |
| Salmon Bay | 46 | 41 | 15 | 142 | 33 | 0 |
| Cape Aniva | 46 | 2 | 20 | 143 | 30 | 20 |
| Cape Lowenorn | 46 | 23 | 10 | 143 | 40 | 0 |
| Cape Tonen | 46 | 50 | 0 | 143 | 33 | 0 |
| Cape Dalrymple | 48 | 21 | 0 | 142 | 50 | 0 |
| Robben I., N. E. Pt. | 48 | 36 | 0 | 144 | 33 | 0 |
| Cape Patience | 48 | 52 | 0 | 144 | 46 | 15 |
| Cape Delisle de la Croyere | 51 | 0 | 30 | 143 | 43 | 0 |
| Downs Point | 51 | 53 | 0 | 143 | 14 | 0 |
| Cape Klokatchiff | 53 | 40 | 0 | 143 | 7 | 0 |
| Cape Lowenstern | 54 | 3 | 15 | 143 | 12 | 30 |
| Cape Elizabeth | 54 | 24 | 30 | 142 | 46 | 30 |
| Cape Maria | 54 | 17 | 30 | 142 | 17 | 45 |
| Nadiejeda Bay | 54 | 10 | 15 | 142 | 27 | 24 |
| Cape Golowatzcheff | 53 | 30 | 15 | 141 | 55 | 0 |
| Boutin Point | 51 | 52 | 0 | 141 | 54 | 0 |
| Martiniere Peak | 50 | 12 | 0 | 142 | 12 | 0 |
| Mongez Peak | 49 | 20 | 0 | 142 | 15 | 0 |
| Bay D'Estaing | 48 | 59 | 38 | 142 | 2 | 0 |
| Bay De Langle | 47 | 44 | 0 | 141 | 58 | 0 |
| *The Kurile Islands.* | | | | | | |
| Kounashir Island, — Traitor's Bay | 43 | 44 | 0 | 145 | 15 | 0 |
| — North East Point | 44 | 29 | 15 | 146 | 8 | 0 |
| Itouroup Island, — Cape Ricord | 44 | 29 | 0 | 146 | 34 | 0 |
| — Cape de Vries | 45 | 37 | 0 | 149 | 1 | 0 |
| — N. E. Point | 45 | 38 | 30 | 149 | 14 | 0 |
| Ouroup Island, — South West Point | 45 | 39 | 0 | 149 | 34 | 0 |
| — North East Point | 46 | 16 | 0 | 150 | 22 | 0 |
| North Torpoy Island | 46 | 32 | 45 | 150 | 37 | 10 |
| South Torpoy Island | 46 | 29 | 15 | 150 | 33 | 30 |
| Broughton Island | 46 | 42 | 30 | 150 | 28 | 30 |
| Simusir I., S. Point | 46 | 51 | 0 | 151 | 37 | 0 |
| — N. W. Point | 47 | 11 | 0 | 151 | 55 | 0 |
| Ketoy Island, S. Point | 47 | 17 | 30 | 152 | 24 | 0 |
| Ushishir I., S. Point | 47 | 32 | 40 | 152 | 38 | 30 |
| Rashau Island | 47 | 47 | 0 | 152 | 55 | 0 |
| Matsua Island, mid. | 48 | 6 | 0 | 153 | 12 | 30 |

## LATITUDES AND LONGITUDES.

| (71) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *The Kurile Islands.* | | | | | | |
| Raoukoko Island | 48 | 16 | 20 | 153 | 15 | 0 |
| Les Embuches, S. end | 48 | 35 | 0 | 153 | 44 | 0 |
| Tchirinkolan Island | 48 | 44 | 0 | 153 | 24 | 0 |
| Shiashkotan I. mid. | 48 | 52 | 0 | 154 | 8 | 0 |
| Ekarma Island | 49 | 0 | 0 | 154 | 8 | 0 |
| KharamoukotanI peak | 49 | 8 | 0 | 154 | 39 | 0 |
| Onnekotau I.,S.W. Pt. | 49 | 19 | 0 | 154 | 44 | 0 |
| Monkonrushy Island | 49 | 51 | 0 | 154 | 32 | 0 |
| Shirinky Island | 50 | 10 | 0 | 154 | 58 | 0 |
| Poromouchir Island, — S. W. Peak | 50 | 15 | 0 | 155 | 12 | 0 |
| Soumashou Island, mid. | 50 | 46 | 0 | 156 | 26 | 0 |
| Alaid Island | 50 | 54 | 0 | 155 | 32 | 0 |

### XX. The Coasts of TASMANIA or VAN DIEMEN'S LAND, and of AUSTRALIA or TERRA AUSTRALIS, with the adjacent Islands.

| | South | | | East | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Tasmania or Van Diemen's Land.* | | | | | | |
| West Point | 41 | 3 | 30 | 144 | 38 | 0 |
| Mount Norfolk | 41 | 24 | 0 | 144 | 58 | 30 |
| Macquarie Harbour, — Cape Sorell | 42 | 10 | 45 | 145 | 16 | 30 |
| Entrance Island | 42 | 11 | 37 | 145 | 19 | 58 |
| Point Hibbs | 42 | 39 | 0 | 145 | 20 | 0 |
| Rocky Point | 43 | 0 | 30 | 145 | 33 | 0 |
| Port Davey, — Pyramidal Rock | 43 | 21 | 0 | 145 | 59 | 0 |
| South West Cape | 43 | 39 | 0 | 146 | 12 | 0 |
| South Cape | 43 | 38 | 0 | 146 | 50 | 0 |
| Mewstone | 43 | 46 | 0 | 146 | 31 | 30 |
| Pedra Blanca | 43 | 50 | 30 | 147 | 7 | 0 |
| Rurick Rock | 44 | 0 | 0 | 147 | 45 | 0 |
| Recherche Bay, — Observatory Point *Var.* 7° 39′ *E.* | 43 | 32 | 17 | 147 | 2 | 30 |
| Tasman's Head | 43 | 31 | 30 | 147 | 26 | 0 |
| Storm Bay, — Cape Raoul | 43 | 18 | 0 | 147 | 54 | 0 |
| Hobart Town, — Fort Mulgrave | 42 | 53 | 35 | 147 | 28 | 0 |
| Cape Pillar | 43 | 11 | 40 | 148 | 6 | 0 |
| C. Frederik Hendrik | 42 | 51 | 30 | 148 | 4 | 0 |
| Maria Island, S. Pt. | 42 | 45 | 0 | 148 | 9 | 0 |
| Schouten I., N. Pt. | 42 | 16 | 0 | 148 | 23 | 0 |
| St. Patrick's Head | 41 | 38 | 0 | 148 | 24 | 0 |
| Swan Islands, largest | 40 | 43 | 30 | 148 | 6 | 15 |
| Cape Portland | 40 | 44 | 0 | 147 | 56 | 30 |
| Port Dalrymple, — Low Head *Var.* 8° 30′ *E.* | 41 | 3 | 30 | 146 | 47 | 30 |
| Cape Grim | 40 | 44 | 0 | 144 | 43 | 0 |
| *Bass' Strait.* | | | | | | |
| Hunter's Islands, — Albatros' Island | 40 | 25 | 0 | 144 | 40 | 30 |
| King's Island, N. Pt. | 39 | 35 | 30 | 143 | 53 | 0 |
| — South Point | 40 | 7 | 15 | 143 | 52 | 30 |
| Sir R. Curtis's Island | 39 | 30 | 0 | 146 | 41 | 0 |
| Kent's Group, E. end | 39 | 29 | 0 | 147 | 19 | 0 |
| Pyramid Rock | 39 | 52 | 40 | 147 | 11 | 30 |

| (72) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Bass' Strait.* | | | | | | |
| Furneaux Islands, | | | | | | |
| — Great I., N. end | 39 | 42 | 30 | 147 | 53 | 30 |
| — The Sisters, N. end | 39 | 38 | 0 | 147 | 55 | 0 |
| — Babel Is., N. end | 39 | 59 | 0 | 148 | 17 | 0 |
| — Cape Barren | 40 | 25 | 15 | 148 | 25 | 45 |
| — Clarke's I, S. Pt. | 40 | 33 | 0 | 148 | 9 | 30 |
| — Cape Franklin | 40 | 21 | 0 | 148 | 0 | 0 |
| Banks' Strait, mid. | 40 | 38 | 0 | 148 | 8 | 0 |
| Cape Otway | 38 | 54 | 0 | 143 | 30 | 0 |
| Port Philip, — Point Nepean | 38 | 18 | 0 | 144 | 38 | 0 |
| Western Port, — Cape Schank *Var.* 8° 30′ *E.* | 38 | 30 | 0 | 144 | 53 | 0 |
| — Point Grant | 38 | 30 | 0 | 145 | 8 | 0 |
| Cape Liptrap | 38 | 53 | 0 | 145 | 54 | 30 |
| Wilson's Promontory | 39 | 11 | 0 | 146 | 25 | 0 |
| Ram Head | 37 | 38 | 0 | 149 | 41 | 0 |
| Cape Howe | 37 | 30 | 0 | 150 | 7 | 0 |
| Twofold Bay, — Snug Cove | 37 | 4 | 0 | 150 | 4 | 0 |
| Cape Dromedary | 36 | 18 | 0 | 150 | 11 | 0 |
| Cape George | 35 | 9 | 0 | 150 | 56 | 0 |
| Jervis Bay, — Bowen's Island | 35 | 6 | 0 | 150 | 55 | 0 |
| Red Point | 34 | 29 | 0 | 151 | 2 | 0 |
| Botany Bay, — Point Solander | 34 | 0 | 45 | 151 | 15 | 50 |
| Port Jackson, — Lighthouse *Var.* 8° 42′ *E.* | 33 | 51 | 11 | 151 | 19 | 45 |
| — Sidney | 33 | 50 | 40 | 151 | 14 | 0 |
| Paramatta, obs. | 33 | 48 | 50 | 151 | 1 | 34 |
| Broken Bay, S. Head | 33 | 34 | 0 | 151 | 21 | 0 |
| Port Hunter, entr. | 32 | 56 | 0 | 151 | 43 | 15 |
| Cape Stephens | 32 | 47 | 35 | 152 | 11 | 40 |
| Cape Hawke | 32 | 13 | 30 | 152 | 33 | 0 |
| Port Macquarie, entr. *Var.* 10° 11′ *E.* | 31 | 25 | 32 | 152 | 57 | 25 |
| Smoky Cape | 30 | 55 | 40 | 153 | 4 | 30 |
| Shoal Bay, entr. | 29 | 26 | 15 | 153 | 22 | 0 |
| Cape Byron | 28 | 38 | 10 | 153 | 37 | 20 |
| Point Danger | 28 | 7 | 0 | 153 | 32 | 0 |
| Point Lookout | 27 | 27 | 0 | 153 | 31 | 0 |
| Brisbane River | 27 | 25 | 0 | 153 | 5 | 0 |
| Cape Moreton | 27 | 1 | 0 | 153 | 26 | 20 |
| Double Island Point | 25 | 55 | 0 | 153 | 14 | 0 |
| Indian Head | 25 | 1 | 0 | 153 | 23 | 0 |
| Sandy Cape | 24 | 42 | 0 | 153 | 16 | 0 |
| *New South Wales.* | | | | | | |
| Port Curtis, — Gatcombe Head | 23 | 52 | 30 | 151 | 24 | 0 |
| Cape Capricorn | 23 | 28 | 30 | 151 | 15 | 0 |
| Cape Keppel | 23 | 27 | 0 | 151 | 4 | 0 |
| Keppel Islands, — Largest, N. end | 23 | 8 | 0 | 150 | 57 | 0 |
| Cape Manifold | 22 | 42 | 0 | 150 | 49 | 0 |
| Port Bowen | 22 | 28 | 28 | 150 | 45 | 30 |
| Harvey's Islands | 22 | 24 | 30 | 150 | 44 | 0 |
| Cape Townshend | 22 | 13 | 30 | 150 | 29 | 0 |
| Thirsty Sound, — Pier Head | 22 | 6 | 53 | 150 | 0 | 10 |

## LATITUDES AND LONGITUDES.

| (73) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Percy Islands, N. end | 21 | 29 | 0 | 150 | 15 | 0 |
| Cape Palmerston . . | 21 | 27 | 0 | 149 | 28 | 0 |
| Cape Hilsborough . | 20 | 53 | 40 | 149 | 0 | 15 |
| Sir J. Smith's Group, | | | | | | |
| — Linné Peak . . | 20 | 40 | 30 | 149 | 9 | 10 |
| Shaw's Peak . . . | 20 | 28 | 0 | 149 | 2 | 55 |
| Penticost Island . . | 20 | 23 | 10 | 148 | 59 | 30 |
| Repulse Bay, | | | | | | |
| — Cape Conway . . | 20 | 32 | 0 | 148 | 54 | 0 |
| Gloucester I., N. end | 19 | 57 | 24 | 148 | 23 | 38 |
| Cape Gloucester . . | 20 | 1 | 50 | 148 | 26 | 15 |
| Cape Upstart . . . | 19 | 41 | 50 | 147 | 44 | 30 |
| Cape Bowling Green | 19 | 19 | 10 | 147 | 23 | 0 |
| Cape Cleveland . . | 19 | 10 | 10 | 146 | 57 | 50 |
| Mount Elliot . . . | 19 | 33 | 10 | 146 | 54 | 25 |
| Magnetic Island, mid. | 19 | 7 | 30 | 146 | 46 | 0 |
| Palm Island, mid. . | 18 | 43 | 5 | 146 | 35 | 15 |
| Point Hillock . . . | 18 | 25 | 0 | 146 | 20 | 0 |
| Mount Hinchinbrook | 18 | 21 | 30 | 146 | 15 | 0 |
| Cape Sandwich . . | 18 | 13 | 20 | 146 | 16 | 40 |
| Double Point . . . | 17 | 39 | 50 | 146 | 6 | 0 |
| Fitzroy I., S. W. end | 16 | 55 | 21 | 145 | 56 | 21 |
| Cape Grafton . . . | 16 | 51 | 20 | 145 | 53 | 5 |
| Snapper Island . . | 16 | 17 | 35 | 145 | 27 | 40 |
| Endeavour R., entr. | 15 | 27 | 4 | 145 | 10 | 49 |
| Cape Bedford . . . | 15 | 16 | 19 | 145 | 17 | 19 |
| C. Flattery, summit . | 14 | 52 | 30 | 145 | 16 | 10 |
| Lizard Island, summit | 14 | 40 | 20 | 145 | 23 | 0 |
| Cape Bowen, Peak . | 14 | 34 | 30 | 144 | 35 | 40 |
| Point Barrow . . . | 14 | 24 | 0 | 144 | 33 | 30 |
| Cape Melville . . . | 14 | 9 | 30 | 144 | 24 | 50 |
| Cape Flinders . . | 14 | 8 | 0 | 144 | 10 | 20 |
| Clack's Island . . . | 14 | 4 | 45 | 144 | 11 | 45 |
| Cape Sidmouth . . | 13 | 24 | 20 | 143 | 30 | 0 |
| Night Island, N. end | 13 | 8 | 0 | 143 | 28 | 40 |
| Cape Direction . . | 12 | 51 | 30 | 143 | 27 | 0 |
| Cape Weymouth . . | 12 | 37 | 15 | 143 | 20 | 35 |
| Fair Cape . . . . | 12 | 25 | 0 | 143 | 11 | 15 |
| Cape Grenville . . | 11 | 57 | 30 | 143 | 8 | 0 |
| Quoin Island . . . | 12 | 24 | 0 | 143 | 23 | 50 |
| Forbes's Island . . | 12 | 16 | 35 | 143 | 18 | 50 |
| Sir Ch Hardy's Is. . | 11 | 53 | 20 | 143 | 23 | 40 |
| Bird Is., N. E. end . | 11 | 44 | 15 | 142 | 58 | 45 |
| Orfordness . . . . | 11 | 18 | 30 | 142 | 43 | 35 |
| Cairncross I., mid. . | 11 | 13 | 30 | 142 | 50 | 35 |
| Turtle Island . . . | 10 | 54 | 0 | 142 | 38 | 40 |
| Albany Islands, Peak | 10 | 43 | 45 | 142 | 35 | 5 |
| York Islands, | | | | | | |
| — Mount Adolphus . | 10 | 38 | 20 | 142 | 36 | 25 |
| Cape York . . . . | 10 | 42 | 40 | 142 | 28 | 50 |
| Endeavour Strait, | | | | | | |
| — Possession Islands | 10 | 44 | 0 | 142 | 20 | 0 |
| Prince of Wales's Is., | | | | | | |
| — Horned Hill . . | 10 | 36 | 35 | 142 | 15 | 0 |
| — Cape Cornwall . | 10 | 45 | 45 | 142 | 8 | 30 |
| — Wednesday Island, | | | | | | |
| North Point . . | 10 | 30 | 10 | 142 | 15 | 0 |
| Wallis's Island, mid. | 10 | 51 | 0 | 142 | 0 | 0 |
| Booby Island, mid. . | 10 | 36 | 0 | 141 | 52 | 50 |
| Alerts Shoal . . . | 9 | 52 | 0 | 140 | 50 | 0 |
| West Island . . . | 10 | 21 | 0 | 141 | 56 | 30 |

| (74) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Hawkesbury Island . | 10 | 23 | 0 | 142 | 5 | 0 |
| Spencer's Island . . | 10 | 18 | 30 | 142 | 4 | 30 |
| Mount Earnest . . | 10 | 14 | 30 | 142 | 26 | 0 |
| Bank's Island, | | | | | | |
| — Mount Augustus . | 10 | 11 | 30 | 142 | 14 | 30 |
| Mulgrave's Island, | | | | | | |
| —North East Point . | 10 | 4 | 0 | 142 | 8 | 0 |
| Jervis's Island, mid. | 9 | 57 | 0 | 142 | 7 | 0 |
| Duythen's Point . . | 12 | 34 | 0 | 141 | 37 | 0 |
| Pera Head . . . . | 12 | 58 | 30 | 141 | 37 | 0 |
| Cape Keerweer . . | 13 | 57 | 0 | 141 | 30 | 0 |
| Siveer's Island . . | 17 | 8 | 15 | 139 | 44 | 52 |
| Allen's I., S. E. end . | 17 | 5 | 0 | 139 | 25 | 0 |
| Wellesleys Islands, | | | | | | |
| — Bountiful Island . | 16 | 41 | 0 | 139 | 59 | 0 |
| —Mornington Island, | | | | | | |
| Cape Vandiemen . | 16 | 32 | 0 | 139 | 49 | 30 |
| Sir Ed. Pellew's Is., | | | | | | |
| — Cape Vanderlyn . | 15 | 34 | 30 | 137 | 11 | 20 |
| — Cape Pellew . . | 15 | 30 | 30 | 137 | 5 | 0 |
| Maria's Island, N.Pt. | 14 | 50 | 0 | 135 | 57 | 30 |
| Groote I., S. W. Pt. . | 14 | 15 | 0 | 136 | 30 | 0 |
| — South East Point . | 14 | 17 | 0 | 137 | 7 | 30 |
| — North Point . . | 13 | 37 | 0 | 136 | 50 | 0 |
| — Central Hill . . | 13 | 56 | 45 | 136 | 46 | 30 |
| Bickerton's I. summit | 13 | 44 | 40 | 136 | 19 | 15 |
| Cape Shield . . . | 13 | 19 | 45 | 136 | 28 | 0 |
| Cape Grey . . . . | 13 | 1 | 0 | 136 | 47 | 0 |
| Mount Caledon . . | 12 | 53 | 30 | 136 | 37 | 40 |
| Point Alexander . . | 12 | 50 | 0 | 136 | 43 | 30 |
| Mount Alexander . . | 12 | 40 | 0 | 136 | 48 | 0 |
| Cape Arnheim . . . | 12 | 18 | 0 | 137 | 5 | 0 |
| Melville's Islands, | | | | | | |
| — Great I., S. end . | 12 | 8 | 30 | 136 | 58 | 0 |
| Melville Bay, | | | | | | |
| — Point Dundas . . | 12 | 13 | 0 | 136 | 46 | 0 |
| Cape Wilberforce . | 11 | 52 | 0 | 136 | 38 | 0 |
| Arnheim Bay, entr. . | 12 | 2 | 0 | 136 | 9 | 0 |
| Cunningham's Island, | | | | | | |
| — South end . . . | 11 | 44 | 0 | 136 | 14 | 0 |
| Point Dale . . . . | 11 | 36 | 0 | 136 | 9 | 0 |
| Wessel's Islands, | | | | | | |
| — Cape Wessels . . | 10 | 59 | 15 | 136 | 46 | 30 |
| Cape Stewart . . . | 11 | 56 | 0 | 134 | 48 | 0 |
| Liverpool River, | | | | | | |
| — Entrance Island . | 11 | 57 | 0 | 134 | 14 | 50 |
| Point Braithwaite . | 11 | 45 | 50 | 133 | 55 | 20 |
| Goulburn's Islands, | | | | | | |
| — North East end . | 11 | 26 | 0 | 133 | 26 | 0 |
| Cape Cockburn . . | 11 | 18 | 0 | 132 | 53 | 5 |
| Croker's I., N. Pt. . | 10 | 58 | 30 | 132 | 34 | 10 |
| Point Smith . . . | 11 | 6 | 45 | 132 | 12 | 30 |
| Cape Don . . . . | 11 | 19 | 30 | 131 | 45 | 30 |
| Alligator Rivers, | | | | | | |
| — Field Island, mid. | 12 | 6 | 0 | 132 | 25 | 10 |
| Melville Island, | | | | | | |
| — Cape Gambier . | 11 | 56 | 0 | 130 | 55 | 0 |
| — Cape Keith . . | 11 | 39 | 0 | 131 | 28 | 0 |
| — Cape Fleeming . | 11 | 12 | 0 | 131 | 22 | 0 |

New South Wales. Torres Strait. Gulf of Carpentaria. Torres Strait. New South Wales. New Holland.

## LATITUDES AND LONGITUDES.

| (75) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Melville Island, | | | | | | |
| — Cape Van Diemen | 11 | 8 | 15 | 130 | 20 | 30 |
| — Port Cockburn, | | | | | | |
| Fort Dundas . . | 11 | 25 | 0 | 130 | 24 | 0 |
| Bathurst Island, | | | | | | |
| — North Point . . | 11 | 19 | 0 | 130 | 13 | 0 |
| — Port Hurd, entr. | 11 | 39 | 30 | 130 | 11 | 0 |
| — Cape Fourcroy | 11 | 51 | 0 | 130 | 0 | 0 |
| Paterson's Bay, | | | | | | |
| — Cape Grose . . | 12 | 32 | 40 | 130 | 26 | 0 |
| Peron's Islands, peak | 13 | 6 | 30 | 130 | 1 | 20 |
| Cape Ford . . . . | 13 | 24 | 35 | 129 | 52 | 20 |
| Port Keats, | | | | | | |
| — Tree Point . . | 13 | 59 | 20 | 129 | 34 | 0 |
| Cape Hay . . . | 14 | 1 | 30 | 129 | 27 | 30 |
| Point Pearce . . | 14 | 24 | 30 | 129 | 17 | 15 |
| Cambridge Gulf, | | | | | | |
| — Lacrosse I., W. end | 14 | 43 | 0 | 128 | 13 | 0 |
| — Cape Domett . | 14 | 47 | 0 | 128 | 23 | 0 |
| — Cape Dussejour | 14 | 42 | 0 | 128 | 8 | 0 |
| Cape Londonderry | 13 | 44 | 0 | 126 | 53 | 50 |
| Jones's Island . . | 13 | 44 | 0 | 126 | 23 | 0 |
| Troughton's Island | 13 | 44 | 10 | 126 | 11 | 15 |
| Cape Bougainville | 13 | 52 | 0 | 126 | 9 | 0 |
| Cassini Island, mid. | 13 | 55 | 5 | 125 | 42 | 0 |
| Admiralty Gulf, | | | | | | |
| — Cape Voltaire, Hill | 14 | 14 | 30 | 125 | 40 | 12 |
| Port Warrender, | | | | | | |
| — Chrystal Head . | 14 | 28 | 0 | 125 | 55 | 30 |
| Montalivet Islands, | | | | | | |
| — N. E. end . . | 14 | 13 | 40 | 125 | 19 | 30 |
| Maret Islands, N. end | 14 | 22 | 15 | 124 | 56 | 40 |
| York Sound, | | | | | | |
| — Cape Pond . . | 14 | 45 | 20 | 125 | 9 | 25 |
| Port Nelson, | | | | | | |
| — Careening Bay | 15 | 6 | 18 | 125 | 0 | 46 |
| Freycinet's Islands | 15 | 0 | 30 | 124 | 32 | 40 |
| Prince Regent's R., | | | | | | |
| — Mount Trafalgar | 15 | 16 | 35 | 125 | 4 | 0 |
| Port George IV., | | | | | | |
| — High Bluff . . | 15 | 14 | 40 | 124 | 41 | 35 |
| — Point Adieu . | 15 | 14 | 10 | 124 | 34 | 45 |
| Red Island . . . | 15 | 13 | 15 | 124 | 15 | 45 |
| Cockell's Islands . | 15 | 48 | 0 | 124 | 4 | 0 |
| MacLeay's Is., largest | 15 | 57 | 0 | 123 | 42 | 0 |
| Cafferelli Island . | 16 | 2 | 25 | 123 | 18 | 35 |
| Point Cunningham | 16 | 39 | 20 | 123 | 10 | 0 |
| Cape Lévêque . . | 16 | 21 | 50 | 122 | 56 | 35 |
| Cape Borda . . . | 16 | 36 | 0 | 122 | 45 | 0 |
| Lacépède Is., N.W. end | 16 | 49 | 40 | 122 | 7 | 20 |
| Baleine Bank, mid. | 16 | 46 | 0 | 121 | 50 | 30 |
| Cape Baskerville . | 17 | 10 | 0 | 122 | 16 | 0 |
| Point Coulomb . | 17 | 21 | 0 | 122 | 11 | 0 |
| Cape Boileau . . | 17 | 38 | 0 | 122 | 14 | 0 |
| Point Gantheaume | 17 | 53 | 0 | 122 | 11 | 0 |
| Cape Villaret . . | 18 | 19 | 15 | 122 | 8 | 45 |
| C. Latouche Treville | 18 | 29 | 0 | 121 | 50 | 50 |
| Cape Bossut . . | 18 | 44 | 0 | 121 | 41 | 0 |
| Cape Jaubert . . | 18 | 55 | 0 | 121 | 36 | 0 |
| Bedout Island . . | 19 | 29 | 0 | 118 | 52 | 0 |
| Cape Lambert . . | 20 | 34 | 30 | 117 | 7 | 0 |
| Delambre I., N. end | 20 | 23 | 35 | 117 | 1 | 25 |

New Holland.

| (76) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Legendre I., N.W. Pt. | 20 | 18 | 45 | 116 | 46 | 0 |
| Dampier's Archipelago | | | | | | |
| — Malus Island, | | | | | | |
| Courtenay Head . | 20 | 29 | 5 | 116 | 36 | 35 |
| — Enderby I., S.W. Pt. | 20 | 35 | 25 | 116 | 23 | 5 |
| — Rosemary Island . | 20 | 27 | 30 | 116 | 31 | 0 |
| Cape Preston . . . | 20 | 49 | 45 | 116 | 5 | 0 |
| Trimouille I., E. end | 20 | 22 | 0 | 116 | 28 | 0 |
| Barrow's Island, | | | | | | |
| — Cape Dupuy . . | 20 | 40 | 0 | 115 | 12 | 0 |
| — Cape Poivre . . | 20 | 52 | 0 | 115 | 9 | 0 |
| Ritchie's Reef . . | 20 | 17 | 40 | 114 | 46 | 6 |
| Exmouth Gulf, | | | | | | |
| — N. W. Cape . . | 21 | 47 | 40 | 114 | 3 | 40 |
| Point Cloates . . . | 22 | 33 | 5 | 113 | 35 | 0 |
| Cape Farquhar . . | 23 | 35 | 0 | 113 | 35 | 35 |
| Cape Cuvier . . . | 24 | 0 | 30 | 113 | 21 | 45 |
| Shark's Bay, | | | | | | |
| — Foure I., mid. . | 25 | 43 | 0 | 114 | 6 | 0 |
| — C. Lesueur . . . | 25 | 38 | 0 | 113 | 26 | 0 |
| — Cape Heurisson . | 25 | 57 | 0 | 113 | 26 | 0 |
| — C. Bellifin . . . | 25 | 57 | 0 | 113 | 18 | 0 |
| Bernier Island, | | | | | | |
| — Cape Ronsard . . | 24 | 45 | 0 | 113 | 7 | 0 |
| Dorre Island, | | | | | | |
| — C. St. Creque . . | 25 | 18 | 0 | 113 | 0 | 0 |
| Naturaliste's Channel | 25 | 25 | 0 | 112 | 57 | 0 |
| Dirk Hartog's Island, | | | | | | |
| — Cape Inscription . | 25 | 28 | 20 | 112 | 55 | 0 |
| Houtman's Abrolhos, | | | | | | |
| — South East part . | 28 | 55 | 0 | 113 | 47 | 0 |
| Cape Leschenault . . | 31 | 21 | 0 | 115 | 30 | 0 |
| Swan River, entrance | 32 | 4 | 31 | 115 | 46 | 43 |
| Rottnest I., N. E. Pt. | 31 | 59 | 30 | 115 | 31 | 12 |
| *Var.* 4° 50′ *W.* | | | | | | |
| Cape Peron . . . . | 32 | 18 | 0 | 115 | 42 | 0 |
| Cape Bouvard . . . | 32 | 37 | 0 | 115 | 33 | 0 |
| Cape Naturaliste . . | 33 | 27 | 30 | 114 | 57 | 53 |
| Cape Leeuwin . . . | 34 | 20 | 0 | 115 | 7 | 0 |
| Low Black Point . . | 34 | 25 | 0 | 115 | 30 | 0 |
| Point D'Entrecasteau | 34 | 52 | 0 | 116 | 1 | 0 |
| White Topped Rocks | 35 | 3 | 0 | 116 | 13 | 0 |
| Cape Chatham, Rocks | 35 | 3 | 0 | 116 | 29 | 0 |
| Point Hillier . . . | 35 | 4 | 0 | 117 | 9 | 0 |
| West Cape Howe . . | 35 | 8 | 30 | 117 | 40 | 0 |
| Eclipse Is., S. end | 35 | 13 | 0 | 117 | 52 | 0 |
| King George's Sound, | | | | | | |
| — Bald Head . . . | 35 | 6 | 15 | 118 | 0 | 45 |
| Mount Gardner . . | 35 | 0 | 30 | 118 | 10 | 0 |
| Bald I., S. E. Point | 34 | 55 | 0 | 118 | 29 | 0 |
| Haul off Rock . . . | 34 | 43 | 0 | 118 | 30 | 0 |
| Cape Knob . . . . | 34 | 33 | 0 | 119 | 14 | 0 |
| Doubtful Islands . . | 34 | 23 | 0 | 119 | 35 | 0 |
| Seal's Island . . . | 34 | 6 | 0 | 120 | 28 | 0 |
| Esperance Bay, | | | | | | |
| — Observatory I., mid. | 33 | 55 | 30 | 121 | 45 | 30 |
| — Cape Le Grand . | 34 | 1 | 0 | 122 | 4 | 0 |
| Lucky Bay, S. E. Pt. | 34 | 0 | 20 | 122 | 14 | 14 |
| Mondrain I., S.W. Pt. | 34 | 10 | 30 | 122 | 13 | 0 |
| Termination Island . | 34 | 30 | 20 | 121 | 58 | 0 |
| Twin Rocks . . . | 34 | 24 | 0 | 122 | 11 | 30 |
| Twin Peaks, S.W. end | 34 | 1 | 0 | 122 | 47 | 0 |

New Holland.

## LATITUDES AND LONGITUDES.

| (77) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *New Holland.* | | | | | | |
| Middle Island, | | | | | | |
| — Goose Island Bay | 34 | 5 | 23 | 123 | 9 | 30 |
| Douglas's Islands, mid. | 34 | 10 | 0 | 123 | 6 | 30 |
| Cape Arid | 34 | 0 | 15 | 123 | 13 | 0 |
| South East Is., S. end | 34 | 20 | 30 | 123 | 27 | 0 |
| Cape Pasley | 33 | 57 | 0 | 123 | 26 | 0 |
| Round Island | 34 | 5 | 0 | 123 | 49 | 30 |
| Point Malcolm | 33 | 48 | 0 | 123 | 41 | 30 |
| Eastern Group, S. end | 33 | 51 | 0 | 124 | 3 | 0 |
| Point Culver | 32 | 57 | 0 | 124 | 39 | 0 |
| Point Dover | 32 | 34 | 0 | 125 | 30 | 0 |
| 1st. Low Sandy Point | 32 | 21 | 30 | 126 | 29 | 0 |
| 2nd. Low Sandy Point | 32 | 1 | 0 | 128 | 15 | 0 |
| Head of the Great Australian Bight | 31 | 29 | 0 | 131 | 8 | 0 |
| Cape Nuyts | 32 | 2 | 0 | 132 | 18 | 0 |
| Point Fowler | 32 | 2 | 0 | 132 | 27 | 0 |
| Point Bell | 32 | 16 | 30 | 133 | 5 | 0 |
| Purdie's Is., W. end | 32 | 20 | 20 | 133 | 10 | 15 |
| St. Francis's Is., W. end | 32 | 33 | 30 | 133 | 13 | 30 |
| St. Peter's Is., W. end | 32 | 22 | 20 | 133 | 27 | 0 |
| Franklin's Is., S.W. end | 32 | 31 | 0 | 133 | 35 | 0 |
| Point Brown | 32 | 37 | 0 | 133 | 48 | 0 |
| Cape Bauer | 32 | 44 | 20 | 133 | 58 | 30 |
| Point Westall | 32 | 52 | 30 | 133 | 58 | 45 |
| Cape Radstock | 33 | 12 | 0 | 134 | 15 | 0 |
| Point Weyland | 33 | 14 | 0 | 134 | 33 | 0 |
| Waldegrave's Is., | | | | | | |
| — West end | 33 | 35 | 30 | 134 | 42 | 30 |
| Flinders' I., S.W. Pt. | 33 | 45 | 30 | 134 | 24 | 15 |
| Pearson's Is., N. Peak | 33 | 57 | 0 | 134 | 13 | 0 |
| Point Drummond | 34 | 10 | 0 | 135 | 13 | 0 |
| Coffin's Bay, | | | | | | |
| — Point Sir Isaac | 34 | 27 | 0 | 135 | 10 | 0 |
| Point Whidley | 34 | 36 | 30 | 135 | 3 | 30 |
| Greenly Is., peak | 34 | 40 | 0 | 134 | 47 | 0 |
| Cape Wiles | 34 | 57 | 0 | 135 | 38 | 30 |
| Liguanea Island | 34 | 59 | 30 | 135 | 34 | 0 |
| Cape Catastrophe | 35 | 0 | 0 | 135 | 56 | 0 |
| Thistle's Island, N. end | 34 | 56 | 0 | 136 | 4 | 0 |
| Spencer's Gulf, | | | | | | |
| — Cape Donington | 34 | 44 | 0 | 135 | 56 | 30 |
| — Port Lincoln, anch. | 34 | 48 | 25 | 135 | 44 | 51 |
| — Point Bolingbroke | 34 | 32 | 40 | 136 | 3 | 0 |
| — Reevesby Island, N. E. end | 34 | 29 | 0 | 136 | 18 | 0 |
| — Mount Young | 33 | 6 | 0 | 137 | 30 | 0 |
| — Point Lowly | 32 | 57 | 40 | 137 | 49 | 0 |
| — Mount Brown | 32 | 30 | 15 | 138 | 0 | 45 |
| — Barn Hill | 33 | 35 | 0 | 138 | 8 | 0 |
| — Point Riley | 33 | 53 | 0 | 137 | 30 | 0 |
| — Point Pierce | 34 | 28 | 30 | 137 | 21 | 0 |
| — Corny Point | 34 | 52 | 0 | 137 | 3 | 0 |
| — Cape Spencer | 35 | 18 | 0 | 136 | 53 | 0 |
| Troubridge Hill | 35 | 8 | 0 | 137 | 41 | 30 |
| Gulf St. Vincent, head | 34 | 8 | 52 | 138 | 6 | 0 |
| — Mount Lofty | 34 | 59 | 0 | 138 | 42 | 0 |
| Cape Jervis | 35 | 38 | 0 | 138 | 9 | 0 |
| Kangaroo Island, | | | | | | |
| — Point Marsden | 35 | 33 | 0 | 137 | 41 | 0 |
| — Kangaroo Head | 35 | 43 | 0 | 137 | 58 | 31 |

| (78) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *New South Wales.* | | | | | | |
| — Cape Willoughby | 35 | 48 | 0 | 138 | 13 | 0 |
| Cape Bernouilly | 36 | 34 | 0 | 139 | 51 | 0 |
| Cape Jaffa | 36 | 57 | 0 | 139 | 41 | 30 |
| Cape Lannes | 37 | 10 | 30 | 139 | 45 | 0 |
| Cape Buffon | 37 | 36 | 0 | 140 | 10 | 0 |
| W. Cape Banks | 37 | 53 | 30 | 140 | 23 | 20 |
| Cape Northumberland | 38 | 2 | 30 | 140 | 37 | 30 |
| Cape Bridgewater | 38 | 22 | 0 | 141 | 18 | 0 |
| Cape Nelson | 38 | 24 | 30 | 141 | 28 | 0 |
| Cape Otway | 38 | 54 | 0 | 143 | 30 | 0 |

## XXI. Islands, Rocks, and Shoals in the NORTH PACIFIC OCEAN.

| | North | | | East | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Ladrone or Marian Islands.* | | | | | | |
| Borodino Island | 25 | 56 | 0 | 131 | 15 | 0 |
| Bishop's Rock | 25 | 20 | 0 | 131 | 15 | 0 |
| Rasa Island | 24 | 26 | 0 | 131 | 3 | 0 |
| Kendrick's Island | 24 | 35 | 0 | 134 | 20 | 0 |
| Cooper's Island | 25 | 48 | 0 | 131 | 36 | 0 |
| Copper Island | 20 | 8 | 0 | 131 | 54 | 0 |
| Abreojos Shoal | 22 | 10 | 0 | 132 | 55 | 15 |
| Abreogoes Shoal | 20 | 59 | 0 | 136 | 38 | 0 |
| Douglas' Reef | 20 | 37 | 0 | 136 | 10 | 0 |
| Bishop's Rock | 20 | 15 | 0 | 136 | 54 | 0 |
| Moore's Island | 31 | 27 | 0 | 145 | 40 | 0 |
| St. Peter's Island | 30 | 30 | 30 | 140 | 15 | 0 |
| Disappointment I. | 27 | 15 | 0 | 139 | 45 | 0 |
| Sylph's Rock | 31 | 25 | 0 | 142 | 40 | 0 |
| Bonin Is. Port Loyd | 27 | 5 | 35 | 142 | 11 | 30 |
| Parry's Group, S. end | 27 | 37 | 30 | 142 | 11 | 0 |
| Coffin's Group | 26 | 30 | 0 | 141 | 10 | 0 |
| Sulphur Island | 24 | 48 | 0 | 141 | 13 | 0 |
| Forfana Island | 25 | 34 | 0 | 143 | 0 | 0 |
| Margaret's Island | 27 | 20 | 0 | 145 | 45 | 0 |
| Grampus' Islands | 25 | 40 | 0 | 146 | 40 | 0 |
| Volcano or Guy's I. | 20 | 30 | 0 | 145 | 46 | 0 |
| Uracas Island | 20 | 10 | 0 | 145 | 32 | 0 |
| Assumption Island | 19 | 45 | 0 | 145 | 35 | 0 |
| Mang's Island | 19 | 32 | 0 | 145 | 33 | 30 |
| Grijan Island, N. Pt. | 18 | 50 | 30 | 145 | 50 | 30 |
| Pagon Island, N. Pt. | 18 | 16 | 30 | 146 | 0 | 0 |
| Alamaguan Island | 18 | 5 | 0 | 146 | 2 | 0 |
| Guguan Island, N.Pt. | 17 | 35 | 30 | 146 | 3 | 30 |
| Tores Rock | 17 | 16 | 30 | 146 | 3 | 0 |
| Seriguan Island | 16 | 40 | 0 | 146 | 0 | 0 |
| Anatajan Island | 16 | 20 | 0 | 145 | 52 | 0 |
| Medinilla Rocks | 16 | 0 | 0 | 146 | 13 | 0 |
| Saypan Island, peak | 15 | 14 | 30 | 145 | 56 | 0 |
| Tinian Island, S. Pt. | 14 | 58 | 0 | 145 | 51 | 15 |
| Agugan Island | 14 | 53 | 44 | 145 | 44 | 0 |
| Rota Island | 14 | 9 | 0 | 145 | 29 | 30 |
| Guam Island, N. Pt. | 13 | 38 | 0 | 145 | 4 | 0 |
| — Apra, Fort | 13 | 25 | 50 | 144 | 51 | 15 |
| — Umatac Bay | 13 | 17 | 15 | 144 | 52 | 0 |
| — South West Point | 13 | 13 | 0 | 144 | 56 | 0 |
| Sta. Rosa Bank, mid. | 12 | 24 | 0 | 144 | 24 | 0 |
| Manurvan Island | 0 | 30 | 30 | 130 | 48 | 0 |
| Lord North's Island | 3 | 2 | 45 | 131 | 4 | 15 |

## LATITUDES AND LONGITUDES.

*New Philippines or Caroline Islands.*

| (79) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Helen's Shoal | 2 | 55 | 30 | 131 | 37 | 30 |
| Pulo Anna | 4 | 38 | 30 | 132 | 3 | 30 |
| Pulo Mariere | 4 | 19 | 30 | 132 | 28 | 15 |
| St. Andrew's Islands | 5 | 20 | 0 | 132 | 16 | 0 |
| St. David's Island | 0 | 55 | 0 | 134 | 21 | 30 |
| Pellew Islands, | | | | | | |
| — Babelthouap, E.Pt. | 7 | 41 | 0 | 134 | 55 | 0 |
| — Northernmost | 8 | 8 | 30 | 134 | 50 | 0 |
| — Southernmost | 6 | 53 | 30 | 134 | 21 | 0 |
| Matelotas Is., N. end | 8 | 41 | 0 | 137 | 40 | 0 |
| — South end | 8 | 17 | 0 | 137 | 33 | 30 |
| Yap Island, S. end | 9 | 30 | 30 | 138 | 8 | 0 |
| Hunter's Shoal | 9 | 57 | 0 | 138 | 10 | 0 |
| Mackenzie's Is., mid. | 10 | 5 | 0 | 139 | 40 | 0 |
| Phillip's Islands | 8 | 6 | 0 | 140 | 50 | 0 |
| Kama Islands | 6 | 30 | 0 | 143 | 0 | 0 |
| Wilson's Islands | 7 | 16 | 0 | 144 | 48 | 0 |
| Faralis Island | 9 | 2 | 0 | 145 | 5 | 0 |
| Five Islands | 7 | 32 | 0 | 145 | 31 | 0 |
| Swedes Island | 7 | 30 | 0 | 146 | 28 | 0 |
| Hawes Islands? | 7 | 30 | 0 | 146 | 38 | 0 |
| Tucker's Island | 7 | 22 | 0 | 146 | 48 | 0 |
| Pigali Island | 8 | 11 | 53 | 147 | 40 | 10 |
| St. Bartholomew's I. | 6 | 35 | 0 | 148 | 47 | 0 |
| Enderby or Kata Is. | 7 | 18 | 0 | 149 | 12 | 0 |
| Poulousouk Island | 6 | 40 | 0 | 149 | 23 | 0 |
| Martires Islands, | | | | | | |
| — Tamatam | 7 | 32 | 17 | 149 | 29 | 53 |
| — Tanadick | 7 | 34 | 18 | 149 | 28 | 38 |
| — Olap | 7 | 37 | 17 | 149 | 30 | 34 |
| Anonymous Island | 8 | 36 | 0 | 150 | 21 | 0 |
| Hall's Islands | 8 | 45 | 0 | 152 | 0 | 0 |
| Hogoleu Islands, | | | | | | |
| — Piso Island | 7 | 42 | 35 | 151 | 49 | 15 |
| — Givry Island | 7 | 8 | 55 | 151 | 51 | 48 |
| — Torres Island | 7 | 20 | 0 | 151 | 28 | 0 |
| — Easternmost I. | 7 | 33 | 0 | 151 | 59 | 0 |
| Somes' Island | 7 | 20 | 0 | 151 | 14 | 0 |
| Royalist Island | 6 | 47 | 0 | 152 | 8 | 0 |
| D'Urville Island | 7 | 5 | 18 | 152 | 36 | 52 |
| Reefs and Islands, | | | | | | |
| — North East end | 8 | 45 | 0 | 152 | 36 | 0 |
| — South West end | 8 | 28 | 0 | 152 | 6 | 0 |
| Mortlock's Islands | 5 | 25 | 0 | 153 | 25 | 0 |
| San Raphael's Island | 7 | 18 | 0 | 153 | 54 | 0 |
| Greenwich Island | 1 | 0 | 0 | 154 | 30 | 0 |
| Bordelaise Island | 7 | 39 | 0 | 155 | 5 | 0 |
| Meaburn's Island | 7 | 44 | 0 | 155 | 18 | 0 |
| Montevarde Island | 3 | 27 | 30 | 155 | 48 | 0 |
| Raven or Valient's Island | 5 | 40 | 0 | 157 | 40 | 0 |
| St. Augustin's Island | 7 | 24 | 0 | 158 | 2 | 0 |
| Ascension Island | 6 | 53 | 0 | 158 | 53 | 0 |
| Musgrave Islands | 6 | 15 | 0 | 159 | 15 | 0 |
| Wellington or Duperry's Islands | 6 | 39 | 40 | 159 | 49 | 3 |
| Mc. Asgill's Islands | 6 | 13 | 30 | 160 | 48 | 0 |
| Qualan Island | 5 | 21 | 30 | 163 | 0 | 42 |
| Arrecifos Islands | 9 | 31 | 0 | 161 | 8 | 0 |
| Brown's Range, | | | | | | |
| — Parry's Island | 11 | 21 | 0 | 162 | 52 | 0 |

*Marshall's Archipelago.*

| (80) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Ralick Islands, | | | | | | |
| — Eschscholtz Is., West end | 11 | 40 | 0 | 165 | 21 | 25 |
| — Rimsky Korsakoff Islands, N. end | 11 | 31 | 0 | 166 | 58 | 0 |
| — South West end | 11 | 8 | 30 | 166 | 26 | 30 |
| — Pescadores Is., mid. | 11 | 19 | 12 | 167 | 35 | 0 |
| — Catharine Island | 9 | 14 | 0 | 166 | 32 | 0 |
| — Lydia Island | 9 | 4 | 0 | 166 | 28 | 0 |
| — Margaret's Island | 8 | 52 | 0 | 166 | 30 | 0 |
| — Princess Island | 8 | 20 | 0 | 167 | 30 | 0 |
| — Musquillo Groupe, middle | 7 | 36 | 0 | 168 | 16 | 0 |
| — Elmore Is, mid. | 7 | 26 | 0 | 168 | 30 | 0 |
| — Bonham Is. S.E. end | 6 | 0 | 0 | 169 | 49 | 20 |
| — Hunter's Island | 5 | 46 | 0 | 169 | 0 | 0 |
| — Baring's Islands | 5 | 55 | 0 | 168 | 13 | 0 |
| — Boston Island | 4 | 45 | 0 | 168 | 10 | 0 |
| Radack Islands, | | | | | | |
| — Dawson's Is., mid | 11 | 48 | 0 | 170 | 7 | 0 |
| — Button's or Koutousoff Islands, mid. | 11 | 11 | 20 | 169 | 50 | 30 |
| — Krusenstern's Is, North end | 10 | 27 | 15 | 170 | 0 | 0 |
| — New Year's Island | 10 | 8 | 30 | 170 | 55 | 15 |
| — Temo Island | 9 | 58 | 0 | 169 | 45 | 0 |
| — Heiden Is., mid. | 9 | 51 | 30 | 169 | 13 | 0 |
| — Chatham Islands | 9 | 9 | 30 | 170 | 24 | 0 |
| — Romanzoff Islands, Port Noel | 9 | 28 | 10 | 170 | 16 | 50 |
| *Var.* 17° 55′ *E.* | | | | | | |
| — Calvert Islands, North West end | 8 | 54 | 20 | 170 | 49 | 0 |
| South East end | 8 | 29 | 30 | 171 | 11 | 0 |
| — Ibbetson's Is., mid. | 8 | 18 | 40 | 171 | 12 | 0 |
| — Arrowsmith's Is., about | 7 | 10 | 0 | 171 | 0 | 0 |
| Daniel's Islands | 7 | 24 | 0 | 172 | 6 | 0 |
| Pedder's Islands | 7 | 10 | 0 | 171 | 54 | 0 |
| Mulgrave Is. S.E. end | 5 | 51 | 0 | 172 | 42 | 0 |
| — North East end | 6 | 20 | 0 | 172 | 30 | 0 |
| — North West end | 6 | 20 | 0 | 172 | 4 | 0 |
| — South West end | 5 | 58 | 0 | 172 | 0 | 0 |

*Gilbert's Archipelago.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Charlotte's Islands | 1 | 55 | 0 | 172 | 55 | 0 |
| Pitt's Island, about | 3 | 0 | 0 | 174 | 30 | 0 |
| Matthew's I., N. end | 2 | 6 | 0 | 173 | 27 | 20 |
| Knoy's Is. S. end | 1 | 20 | 0 | 173 | 0 | 40 |
| Marshall's or Gilbert's Island, mid. | 1 | 16 | 15 | 173 | 4 | 20 |
| Hall's Island, N. end | 0 | 59 | 19 | 173 | 4 | 45 |
| Woodle I., N. end | 0 | 16 | 0 | 173 | 27 | 15 |
| — South end | 0 | 10 | 50 | 173 | 29 | 40 |
| Henderville Is., N. end | 0 | 12 | 10 | 173 | 42 | 0 |
| — South end | 0 | 5 | 50 | 173 | 43 | 0 |
| Phebe Island | 0 | 12 | 0 | 176 | 50 | 0 |
| Kingsmill's Groupe, South | | | | | | |
| — Dundas Island | 0 | 15 | 0 | 174 | 0 | 0 |
| Sydenham Is., N. end | 0 | 32 | 0 | 174 | 24 | 0 |
| — South end | 0 | 47 | 0 | 174 | 34 | 0 |
| — Drummond's I., North end | 1 | 1 | 0 | 174 | 46 | 0 |

## LATITUDES AND LONGITUDES.

| (81) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| — Drummond's Is. South end | 1 | 33 | 30 | 175 | 10 | 50 |
| — Nautilus' Reef | 1 | 33 | 40 | 175 | 5 | 0 |
| — Byron's Island | 1 | 18 | 0 | 177 | 45 | 0 |
| North | | | | | | |
| Jardines or Marshall's Island | 21 | 40 | 0 | 151 | 35 | 0 |
| Bennett's Island | 24 | 19 | 0 | 154 | 36 | 0 |
| Wakes Reef | 33 | 0 | 0 | 153 | 0 | 0 |
| Rico de Oro or Lot's Wife | 29 | 51 | 0 | 157 | 4 | 0 |
| Colunas Islands | 28 | 53 | 0 | 162 | 0 | 0 |
| Decker's Island | 23 | 24 | 0 | 163 | 5 | 0 |
| St. Bartholomew's I. | 15 | 10 | 0 | 163 | 43 | 0 |
| Halcyon Island | 19 | 23 | 0 | 165 | 33 | 0 |
| Wake's Island | 19 | 0 | 0 | 166 | 40 | 0 |
| Gasper Rico or Cornwallis Islands | 14 | 30 | 0 | 168 | 42 | 0 |
| Crespo Island, or Roco de Plata | 32 | 46 | 0 | 170 | 10 | 0 |
| Wake's Rock | 17 | 40 | 0 | 172 | 40 | 0 |
| Patrocino Island | 28 | 9 | 0 | 175 | 48 | 0 |
| Mellish's Bank | 34 | 0 | 0 | 178 | 18 | 0 |
| Gaspar Island | 15 | 0 | 0 | 176 | 18 | 0 |
| Massachuset's Islands | 22 | 28 | 0 | 176 | 40 | 0 |
| | | | | West | | |
| Ocean's or Staver's I. | 28 | 24 | 0 | 178 | 42 | 0 |
| Curé Island | 28 | 25 | 0 | 178 | 25 | 0 |
| Barbas Island | 8 | 54 | 0 | 178 | 0 | 0 |
| Pearle and Hermes Bank | 27 | 46 | 0 | 176 | 0 | 0 |
| Krusenstern's Rock | 22 | 15 | 0 | 175 | 47 | 0 |
| Lisiansky's Island | 26 | 3 | 0 | 173 | 42 | 0 |
| Lassion's Island | 26 | 6 | 0 | 173 | 33 | 0 |
| Bunker Island | 28 | 0 | 0 | 173 | 30 | 0 |
| Maro's Reef | 25 | 28 | 0 | 170 | 20 | 0 |
| Johnston's or Smith's Island | 16 | 53 | 20 | 169 | 31 | 30 |
| Two Brother's Rocks | 24 | 14 | 0 | 168 | 30 | 0 |
| Polland's Island | 24 | 48 | 0 | 168 | 0 | 0 |
| Allen's Breakers | 25 | 0 | 0 | 167 | 54 | 0 |
| Gardner's Island | 25 | 8 | 0 | 167 | 40 | 0 |
| Wilson's Island | 19 | 21 | 0 | 166 | 55 | 0 |
| French Frigate Shoal | 23 | 45 | 0 | 165 | 50 | 0 |
| Malloon's Island | 19 | 23 | 0 | 165 | 23 | 0 |
| Necker Island | 23 | 34 | 0 | 164 | 32 | 0 |
| Bird's Island | 23 | 6 | 0 | 161 | 52 | 0 |
| Tahoora Island | 21 | 39 | 0 | 160 | 32 | 0 |
| Oneehou Island, S. Pt. | 21 | 46 | 30 | 160 | 10 | 0 |
| Oreehoua Island | 22 | 2 | 0 | 160 | 7 | 0 |
| Atooi Island, S. E. Pt. | 21 | 51 | 0 | 159 | 30 | 0 |
| — West Point | 22 | 4 | 0 | 159 | 50 | 0 |
| — Whymea Road | 21 | 54 | 0 | 159 | 41 | 45 |
| Woahoo Island, E. Pt. | 21 | 19 | 30 | 157 | 40 | 0 |
| — North Point | 21 | 43 | 0 | 158 | 0 | 0 |
| — Honorooroo Port *Var.* 10° 0′ *E.* | 21 | 17 | 57 | 157 | 56 | 0 |
| — Whymea Bay | 21 | 38 | 0 | 158 | 0 | 0 |
| — Whyteete Road | 21 | 16 | 42 | 157 | 47 | 0 |
| Morotoi Island, E. Pt. | 21 | 9 | 0 | 156 | 44 | 0 |
| Ranai Island, N.W.Pt. | 20 | 58 | 30 | 157 | 3 | 0 |

*Sandwich Islands.*

| (82) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Marokinni Island | 20 | 37 | 0 | 156 | 30 | 0 |
| Tahoorowa Island, — North East Point | 20 | 36 | 0 | 156 | 34 | 0 |
| Mowee I., N. W. Pt. | 21 | 3 | 0 | 156 | 37 | 0 |
| — East Point | 20 | 44 | 40 | 156 | 2 | 40 |
| — Raheina Bay | 20 | 50 | 0 | 156 | 41 | 0 |
| Owhyhee or Hawaii I., — North Point | 20 | 18 | 30 | 155 | 58 | 0 |
| — South Point | 18 | 54 | 0 | 155 | 45 | 0 |
| — East Point | 19 | 32 | 0 | 154 | 50 | 0 |
| — Whytee or Byron's Bay | 19 | 43 | 51 | 155 | 7 | 10 |
| — Karakakoa Bay *Var.* 10° 14′ *E.* | 19 | 28 | 2 | 156 | 0 | 0 |
| — Kowroa Bay | 19 | 37 | 30 | 156 | 5 | 30 |
| — Toeaigh Bay | 20 | 3 | 0 | 155 | 58 | 0 |
| Palmyra Island | 5 | 50 | 0 | 162 | 30 | 0 |
| Prospect Island | 4 | 44 | 0 | 161 | 37 | 0 |
| Washington's Island | 4 | 30 | 0 | 159 | 50 | 0 |
| America Islands | 3 | 48 | 0 | 159 | 15 | 0 |
| Fanning's Island | 3 | 49 | 0 | 158 | 50 | 0 |
| Christmas or Noel I. | 1 | 58 | 0 | 157 | 32 | 0 |
| Guadaloupe I., S. Pt. | 28 | 53 | 0 | 118 | 15 | 45 |
| Roca Pardora Island | 16 | 10 | 0 | 136 | 10 | 0 |
| Misipi Island | 16 | 21 | 0 | 132 | 57 | 0 |
| Alijos Rocks? | 24 | 48 | 0 | 115 | 33 | 0 |
| Sta. Rosa Island | 18 | 19 | 0 | 115 | 6 | 30 |
| Shelvoes Island | 22 | 5 | 0 | 112 | 32 | 0 |
| Neublada? | 18 | 12 | 0 | 114 | 3 | 0 |
| Roca Partida | 19 | 4 | 30 | 111 | 6 | 30 |
| Cloud's Island | 18 | 24 | 0 | 114 | 48 | 0 |
| Best's Island | 18 | 4 | 0 | 114 | 21 | 0 |
| Socorro Island — Cornwallis Bay | 18 | 48 | 0 | 110 | 10 | 0 |
| St. Berto Island | 19 | 20 | 0 | 109 | 52 | 0 |
| Passion Rock | 16 | 54 | 0 | 109 | 6 | 0 |
| Clipperton Rock | 10 | 18 | 0 | 109 | 19 | 0 |
| Duncan's Island | 6 | 0 | 0 | 106 | 0 | 0 |
| Cocos Island | 5 | 34 | 10 | 86 | 59 | 0 |
| Malpello Island | 3 | 59 | 0 | 80 | 10 | 0 |
| Culpepper's Island | 1 | 42 | 0 | 91 | 34 | 0 |
| Wenman's Island | 1 | 22 | 0 | 91 | 16 | 0 |
| Abingdon's Island, — Nories' Rocks | 0 | 48 | 0 | 90 | 20 | 40 |
| — Cape Ibbetson | 0 | 30 | 45 | 90 | 15 | 45 |
| — Chalmers' Point | 0 | 31 | 30 | 90 | 20 | 15 |
| Bindlo Island, N. Pt. | 0 | 21 | 15 | 90 | 6 | 0 |
| Euro Island | 0 | 22 | 30 | 89 | 42 | 0 |
| Albemarle Island, — Albemarle Point | 0 | 15 | 0 | 90 | 58 | 0 |
| — Cape Marshall | 0 | 1 | 30 | 90 | 50 | 0 |
| — Cape Berkley | 0 | 4 | 0 | 91 | 21 | 30 |
| South | | | | | | |
| — Cape Barrington | 0 | 48 | 30 | 90 | 37 | 0 |
| — Cape Woodford | 0 | 56 | 0 | 90 | 36 | 0 |
| — Cape Rose | 1 | 0 | 0 | 90 | 52 | 0 |
| — Cape Christopher | 0 | 51 | 0 | 91 | 12 | 0 |
| James' Island | | | | | | |
| — Cape Stephens | 0 | 5 | 0 | 90 | 22 | 0 |
| — Cape Nepean | 0 | 28 | 0 | 90 | 26 | 0 |

*Galapagos Islands.*



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## LATITUDES AND LONGITUDES.

Galapagos Islands.

| (83) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| James' Island, | | | | | | |
| — Sugar Loaf | 0 | 18 | 0 | 90 | 26 | 0 |
| Narborough Island, | | | | | | |
| — Cape Douglas | 0 | 17 | 0 | 91 | 22 | 0 |
| — Cape Hammond | 0 | 32 | 30 | 91 | 10 | 15 |
| Enchanted Island | 0 | 31 | 0 | 90 | 40 | 0 |
| White Rocks | 0 | 33 | 36 | 90 | 32 | 0 |
| Norfolk Island, | | | | | | |
| — East Point | 0 | 41 | 0 | 90 | 3 | 0 |
| — West Point | 0 | 40 | 0 | 90 | 20 | 30 |
| — North East Point | 0 | 33 | 36 | 90 | 10 | 0 |
| Barrington Island, | | | | | | |
| — North East Point | 0 | 49 | 0 | 89 | 48 | 30 |
| — South West Point | 0 | 55 | 0 | 89 | 56 | 0 |
| Crossman Island | 0 | 57 | 0 | 90 | 28 | 0 |
| Bruttle Island | 0 | 59 | 0 | 90 | 37 | 0 |
| Chatham I., E. Pt. | 0 | 49 | 0 | 88 | 47 | 0 |
| — West Point | 1 | 1 | 30 | 89 | 25 | 0 |
| Hood Island, | | | | | | |
| — Gardner's Bay | 1 | 18 | 0 | 89 | 30 | 0 |
| Champion Island | 1 | 14 | 0 | 89 | 58 | 15 |
| Enderby Island | 1 | 17 | 0 | 90 | 0 | 0 |
| Watson's Island | 1 | 20 | 0 | 89 | 58 | 0 |
| Gardner's Island | 1 | 23 | 0 | 89 | 57 | 30 |

## XXII. Islands, Rocks, and Shoals in the SOUTH PACIFIC OCEAN.

| | South | | | East | | |
|---|---|---|---|---|---|---|
| New Guinea, | | | | | | |
| — Cape Saley | 1 | 26 | 0 | 131 | 3 | 0 |
| — Cape of Good Hope | 0 | 20 | 0 | 132 | 31 | 0 |
| — Cape Dory or Flat Point | 0 | 46 | 0 | 134 | 25 | 0 |
| — Cape Valah | 8 | 26 | 0 | 136 | 54 | 0 |
| — Cape Rodney | 10 | 3 | 0 | 148 | 30 | 0 |
| — South East Cape | 8 | 42 | 55 | 148 | 25 | 0 |
| — Riche Island, North Point | 8 | 2 | 0 | 147 | 57 | 20 |
| — Cape Longuehue | 7 | 22 | 0 | 147 | 23 | 20 |
| — Cretin Is., S. end | 6 | 47 | 45 | 147 | 49 | 40 |
| — King William's C. | 6 | 16 | 30 | 147 | 44 | 0 |
| Torres or Endeavour Straits, | | | | | | |
| — Pandoras' Reef | 11 | 24 | 0 | 143 | 58 | 0 |
| — Murray's Island | 9 | 54 | 0 | 144 | 0 | 0 |
| — Darnley's Island | 9 | 33 | 0 | 143 | 41 | 0 |
| — Halfway Island | 10 | 7 | 0 | 143 | 16 | 0 |
| — Booby Island | 10 | 36 | 0 | 141 | 52 | 50 |
| — Turnagain Island | 9 | 34 | 0 | 142 | 17 | 0 |
| — Deliverance Island | 9 | 32 | 0 | 141 | 42 | 0 |
| Louisiade Islands, | | | | | | |
| — Satisfaction or Roussel Island, Cape Deliverance | 11 | 20 | 37 | 154 | 26 | 0 |
| — Renard Is., W. end | 10 | 52 | 40 | 153 | 1 | 0 |
| — St. Aignan Island, Cape Henry | 10 | 41 | 15 | 152 | 56 | 0 |
| D'Entrecasteaux Is., Cape Pierson | 9 | 55 | 10 | 151 | 14 | 50 |
| — Jouveney Island | 8 | 43 | 0 | 151 | 43 | 0 |
| — Jourien Island | 8 | 37 | 0 | 151 | 22 | 0 |

| (84) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| D'Entrecasteaux Is., | | | | | | |
| — Trobriand Islands, Cape Denis | 8 | 24 | 0 | 151 | 4 | 40 |
| — North Island | 8 | 18 | 0 | 150 | 50 | 0 |
| Laughlan Is., S. end | 9 | 20 | 0 | 153 | 40 | 0 |
| Jones's Islands, | | | | | | |
| — Pocklington's Reef, South end | 10 | 53 | 0 | 155 | 13 | 0 |
| Stephen's Island | 0 | 22 | 0 | 135 | 9 | 0 |
| Tiger Island | 1 | 45 | 0 | 142 | 0 | 0 |
| Matty Island | 1 | 33 | 40 | 143 | 12 | 30 |
| Durour Island | 1 | 46 | 0 | 142 | 56 | 0 |
| Exchequer or Bougainville's I., S. end | 1 | 40 | 30 | 144 | 3 | 0 |
| The Hermits, N.E. end | 1 | 28 | 30 | 145 | 7 | 0 |
| Commerson Island | 0 | 45 | 0 | 145 | 15 | 0 |
| Anchorites Is., S. end | 0 | 54 | 0 | 145 | 30 | 0 |
| Sidney's Shoal | 3 | 20 | 0 | 146 | 50 | 0 |
| Admiralty Islands, | | | | | | |
| — Grand I., N.W. Pt. | 1 | 57 | 0 | 146 | 35 | 0 |
| South East Point | 2 | 16 | 0 | 147 | 18 | 0 |
| — Negro Is., N.E. end | 1 | 58 | 50 | 147 | 16 | 50 |
| — Purdy's Is., E. end | 2 | 50 | 0 | 146 | 15 | 0 |
| — Elizabeth Island | 2 | 55 | 0 | 146 | 49 | 0 |
| — Jesus Maria Island, South East Point | 2 | 22 | 0 | 147 | 48 | 0 |
| — Vandola Island | 2 | 14 | 0 | 148 | 10 | 0 |
| — Raphael Island | 2 | 5 | 0 | 147 | 42 | 0 |
| — Circular Reef | 3 | 18 | 0 | 147 | 40 | 0 |
| Portland Is., N. E. Pt. | 2 | 36 | 0 | 149 | 38 | 45 |
| Mathias Island | 1 | 32 | 0 | 149 | 30 | 0 |
| Squally Island | 1 | 39 | 0 | 150 | 30 | 0 |
| New Hanover Island, | | | | | | |
| — North Point | 2 | 22 | 0 | 150 | 0 | 0 |
| — Q. Charlotte's C. | 2 | 31 | 0 | 149 | 50 | 0 |
| Byron or Mausoleum Island | 2 | 44 | 30 | 150 | 31 | 0 |
| Sandwich I., peak | 2 | 55 | 0 | 150 | 44 | 0 |
| New Ireland, | | | | | | |
| — Cape Byron | 2 | 46 | 0 | 150 | 33 | 0 |
| — Point Hunter | 4 | 37 | 0 | 152 | 38 | 0 |
| — Port Carteret | 4 | 39 | 0 | 152 | 43 | 0 |
| — Port Gower or Praslin | 4 | 47 | 45 | 152 | 48 | 29 |
| — Cape St. George | 4 | 51 | 0 | 152 | 48 | 15 |
| — Cape St. Mary | 4 | 2 | 0 | 153 | 18 | 0 |
| — Slinger's Bay | 3 | 10 | 0 | 152 | 0 | 0 |
| Fisher's I., N. W. Pt. | 2 | 32 | 0 | 152 | 12 | 0 |
| Day's or Deny's I. | 3 | 10 | 0 | 152 | 45 | 0 |
| Oraison Island | 3 | 30 | 0 | 153 | 28 | 0 |
| St. John's Island | 3 | 52 | 0 | 154 | 0 | 0 |
| Sir Charles Hardy's I. | 4 | 41 | 0 | 154 | 20 | 0 |
| Fead Islands, N. end | 3 | 9 | 0 | 154 | 22 | 0 |
| — Goodman's Island | 3 | 27 | 0 | 154 | 45 | 0 |
| — Bank | 3 | 33 | 0 | 154 | 37 | 0 |
| Lyras' Shoal, mid. | 1 | 53 | 0 | 153 | 28 | 0 |
| New Britain, | | | | | | |
| — Cape Stephens | 4 | 0 | 0 | 152 | 0 | 0 |
| — Cape Palliser | 4 | 27 | 0 | 152 | 14 | 0 |
| — Cape Buller | 5 | 8 | 0 | 152 | 9 | 0 |
| — Cape Orford | 5 | 31 | 0 | 152 | 4 | 0 |
| — Port Montague | 6 | 6 | 0 | 150 | 30 | 0 |

## LATITUDES AND LONGITUDES.

| (85) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| New Britain, | | | | | | |
| — South Point | 6 | 28 | 0 | 149 | 32 | 0 |
| — Cape Ann | 5 | 49 | 0 | 148 | 24 | 0 |
| — Cape Glocester | 5 | 28 | 30 | 148 | 25 | 0 |
| — Cape Raoult | 5 | 27 | 0 | 148 | 55 | 0 |
| — Cape Lambert | 4 | 12 | 0 | 151 | 41 | 0 |
| Isle of Man | 3 | 56 | 0 | 151 | 56 | 0 |
| Duke of York's Island, | | | | | | |
| — Port Hunter | 4 | 7 | 30 | 152 | 10 | 0 |
| Duportail Island | 4 | 56 | 0 | 151 | 17 | 0 |
| Willaumez Island, | | | | | | |
| — South Point | 5 | 15 | 3 | 149 | 59 | 45 |
| Raoult Island | 5 | 21 | 0 | 149 | 57 | 0 |
| Merite Island | 4 | 54 | 0 | 149 | 4 | 40 |
| North Island | 4 | 31 | 0 | 149 | 4 | 40 |
| Sir G. Rooke's Island, | | | | | | |
| — South East Point | 5 | 50 | 0 | 147 | 56 | 0 |
| — North West Point | 5 | 25 | 0 | 147 | 44 | 0 |
| Volcano Island | 5 | 32 | 0 | 148 | 4 | 0 |
| Crown Island, mid. | 5 | 15 | 0 | 147 | 20 | 0 |
| Long Island, S. Point | 5 | 50 | 0 | 147 | 0 | 0 |
| Bouka Island, N. Pt. | 5 | 0 | 30 | 154 | 35 | 0 |
| Bougainville Island, | | | | | | |
| — Cape Laverdy | 5 | 32 | 0 | 154 | 55 | 0 |
| — Cape Le Cras | 5 | 51 | 0 | 155 | 5 | 0 |
| — Cape Friendship | 6 | 45 | 0 | 155 | 42 | 0 |
| Shortland Island, | | | | | | |
| — Cape Stephens | 7 | 10 | 0 | 155 | 40 | 0 |
| Treasury Is., largest | 7 | 23 | 30 | 155 | 29 | 15 |
| New Georgia, | | | | | | |
| — Cape Cornwallis | 6 | 36 | 0 | 156 | 20 | 0 |
| — Cape Alexander | 6 | 48 | 0 | 156 | 4 | 0 |
| — Choiseul Bay, ent. | 7 | 0 | 0 | 156 | 3 | 0 |
| — Cape Fleurieu | 7 | 33 | 0 | 157 | 13 | 0 |
| — Cape Labé | 7 | 16 | 0 | 157 | 14 | 0 |
| — Cape Allen | 7 | 28 | 0 | 156 | 14 | 0 |
| — Cape Middleton | 7 | 44 | 0 | 156 | 26 | 0 |
| Cape Satisfaction, | | | | | | |
| — Eddystone Island | 8 | 18 | 0 | 156 | 30 | 40 |
| Cape Deception | 8 | 41 | 0 | 157 | 19 | 30 |
| Cape Pleasant | 8 | 45 | 0 | 157 | 35 | 30 |
| Cape Nepean | 8 | 51 | 30 | 157 | 48 | 45 |
| Cape Pitt | 8 | 53 | 0 | 158 | 14 | 30 |
| Bridgewater Reef | 8 | 54 | 0 | 157 | 12 | 0 |
| Princess Island | 9 | 5 | 0 | 157 | 6 | 0 |
| Manning Strait | 7 | 38 | 0 | 157 | 30 | 0 |
| Ysabel Island, | | | | | | |
| — Cape Comfort | 7 | 15 | 0 | 157 | 45 | 0 |
| — Port Praslin | 7 | 25 | 0 | 157 | 56 | 0 |
| — Estrella Bay | 7 | 48 | 0 | 158 | 44 | 0 |
| — Cape Freycinet | 8 | 25 | 0 | 159 | 5 | 0 |
| Nairn Island | 7 | 42 | 0 | 157 | 52 | 0 |
| Ortega Island | 8 | 10 | 0 | 159 | 22 | 0 |
| Murray's Island | 9 | 3 | 0 | 158 | 50 | 0 |
| Cape Marsh | 9 | 6 | 0 | 159 | 8 | 0 |
| Guadalcunar Island, | | | | | | |
| — Cape Esperance | 9 | 16 | 30 | 159 | 45 | 35 |
| — Cape Hunter | 9 | 49 | 30 | 159 | 57 | 0 |
| — Cape Henslow | 9 | 59 | 0 | 160 | 39 | 0 |
| — North East Cape | 9 | 49 | 15 | 160 | 53 | 0 |
| Ramos Islands | 8 | 23 | 0 | 160 | 4 | 0 |

Solomon's Archipelago.

| (86) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Gower's Island | 7 | 56 | 0 | 160 | 28 | 0 |
| Carteret I., N.W. Pt. | 8 | 23 | 0 | 160 | 31 | 0 |
| Arsacedes I., S. Pt. | 9 | 8 | 0 | 161 | 22 | 0 |
| Contrariety or Smith's Island | 9 | 48 | 0 | 162 | 8 | 10 |
| Three Sisters, mid. | 10 | 12 | 0 | 162 | 0 | 0 |
| San Christoval Island, | | | | | | |
| — C. de la Recherche | 10 | 12 | 30 | 161 | 22 | 0 |
| — Cape Philip | 10 | 33 | 0 | 161 | 32 | 0 |
| — Cape Sidney | 10 | 48 | 0 | 161 | 50 | 0 |
| — Cape Surville or Oriental | 10 | 50 | 0 | 162 | 22 | 0 |
| Deliverance Islands, | | | | | | |
| — Sta Anna | 10 | 51 | 0 | 162 | 28 | 0 |
| — Sta Catalina | 10 | 53 | 10 | 162 | 26 | 30 |
| Bellona Bank | 11 | 11 | 0 | 159 | 50 | 0 |
| Rennell Is., S. E. Pt | 11 | 38 | 0 | 160 | 41 | 0 |
| Well's Reef | 12 | 20 | 0 | 158 | 43 | 0 |
| Pandoras' Reef, N.end | 12 | 6 | 0 | 160 | 34 | 0 |
| Indispensable Reef, S. end | 12 | 46 | 0 | 160 | 42 | 0 |
| Green or Shortland I. | 4 | 50 | 0 | 155 | 15 | 0 |
| Cocos Isles | 4 | 36 | 0 | 156 | 30 | 0 |
| Mortlock Island | 4 | 45 | 0 | 157 | 0 | 0 |
| Ontong Java Islands, | | | | | | |
| — Port Princessa, ent | 4 | 50 | 0 | 156 | 49 | 0 |
| Lord Howe's Group | 5 | 30 | 0 | 159 | 20 | 0 |
| Candelaria Shoals | 6 | 15 | 0 | 159 | 14 | 0 |
| Bradley's Shoals | 6 | 52 | 0 | 161 | 0 | 0 |
| Stewart's Islands | 8 | 26 | 0 | 163 | 0 | 0 |
| Low Islands | 10 | 11 | 0 | 165 | 37 | 0 |
| Swallow Island | 10 | 13 | 0 | 166 | 32 | 0 |
| Duff's Group | 9 | 57 | 0 | 167 | 0 | 0 |
| Volcano Island | 10 | 24 | 0 | 165 | 45 | 0 |
| Santa Cruz or Tomarico Island, | | | | | | |
| — Cape Byron | 10 | 41 | 0 | 166 | 4 | 30 |
| — Cape Boscowen | 10 | 51 | 15 | 165 | 43 | 35 |
| — Cape Mendana | 10 | 54 | 0 | 165 | 50 | 0 |
| — Cape Barrington | 10 | 49 | 0 | 166 | 2 | 0 |
| Guerta Island | 10 | 40 | 0 | 165 | 45 | 30 |
| Lord Howe's Island | 10 | 49 | 0 | 166 | 1 | 0 |
| Edgecumbe or Paiou Island, | | | | | | |
| — North Point | 11 | 15 | 15 | 166 | 28 | 0 |
| Oury or Whanoo I., — West Point | 11 | 22 | 0 | 166 | 31 | 30 |
| Recherche or Pitt's I. | 11 | 40 | 0 | 166 | 45 | 0 |
| Tucopia or Barwell's Island | 12 | 15 | 0 | 169 | 50 | 0 |
| Cherry Island | 11 | 35 | 0 | 170 | 20 | 0 |
| Mitre Island | 11 | 55 | 0 | 170 | 0 | 0 |
| Pandoras Reef | 12 | 11 | 0 | 172 | 0 | 0 |
| North Rocks | 13 | 16 | 0 | 168 | 58 | 0 |
| Bank's Islands, | | | | | | |
| — Sugar Loaf Island | 13 | 52 | 0 | 169 | 4 | 0 |
| Blith or Torres I. | 13 | 29 | 0 | 167 | 52 | 0 |
| Star Island | 14 | 22 | 0 | 168 | 8 | 0 |
| Espirito Santo Island, | | | | | | |
| — Cape Cumberland | 14 | 38 | 45 | 166 | 49 | 30 |

Charlotte's or Santa Cruz Islands.

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## LATITUDES AND LONGITUDES.

| (87) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| **New Hebrides.** | | | | | | |
| Espirito Santo Island, | | | | | | |
| — Cape Quiros | 14 | 56 | 0 | 167 | 14 | 0 |
| — Port Vera Cruz | 15 | 15 | 0 | 167 | 8 | 0 |
| — Cape Lisburne | 15 | 40 | 0 | 166 | 59 | 0 |
| Bartholomew's Island | 15 | 42 | 0 | 167 | 24 | 0 |
| Leper's Island | 15 | 22 | 0 | 168 | 0 | 0 |
| Aurora Island, N. Pt | 14 | 53 | 0 | 168 | 16 | 0 |
| Whitsun Island, S. Pt. | 15 | 59 | 0 | 168 | 28 | 0 |
| Ambrym Island, E. Pt. | 16 | 19 | 0 | 168 | 30 | 0 |
| Paoom Island | 16 | 27 | 0 | 168 | 26 | 0 |
| Mallicolo I., N.W. Pt. | 15 | 51 | 0 | 167 | 23 | 0 |
| — Port Sandwich | 16 | 25 | 20 | 167 | 57 | 20 |
| Maskelyne Islands | 16 | 32 | 0 | 168 | 0 | 0 |
| Johnston's Islands | 16 | 53 | 20 | 169 | 31 | 30 |
| Apee Island, mid.. | 16 | 43 | 0 | 168 | 30 | 0 |
| Shepherd's Is., largest | 16 | 54 | 0 | 168 | 46 | 0 |
| Monument Island | 17 | 0 | 0 | 168 | 50 | 0 |
| The Three Hills | 17 | 3 | 0 | 168 | 34 | 0 |
| The Two Hills | 17 | 14 | 0 | 168 | 37 | 0 |
| Montague Island | 17 | 26 | 0 | 168 | 32 | 0 |
| Hinchinbroke Island | 17 | 32 | 0 | 168 | 42 | 0 |
| Sandwich Island, S. Pt. | 17 | 52 | 0 | 168 | 50 | 0 |
| Erromango Island, | | | | | | |
| — Traitor's Head | 18 | 46 | 0 | 169 | 28 | 0 |
| Tanna Island, N. Pt. | 19 | 20 | 0 | 168 | 30 | 0 |
| — Port Resolution | 19 | 32 | 25 | 169 | 44 | 30 |
| *Var.* 7° 14′ *E.* | | | | | | |
| Erronam Island | 19 | 31 | 0 | 170 | 20 | 0 |
| Annatim Island | 20 | 3 | 0 | 170 | 4 | 0 |
| **New Caledonia.** | | | | | | |
| Huon Is., N. Reef | 17 | 57 | 0 | 162 | 41 | 0 |
| Point Tonnere | 20 | 24 | 0 | 164 | 0 | 0 |
| Port St. Vincent | 22 | 0 | 10 | 165 | 55 | 0 |
| Cape Prince of Wales | 22 | 29 | 0 | 166 | 42 | 0 |
| Q. Charlotte's Cape | 22 | 16 | 0 | 166 | 52 | 0 |
| Cape Colnet | 20 | 29 | 0 | 164 | 44 | 0 |
| Balade Harbour | 20 | 17 | 25 | 164 | 27 | 0 |
| Beaupre's Islands | 20 | 15 | 30 | 166 | 6 | 0 |
| Isle of Pines | 22 | 38 | 0 | 167 | 20 | 0 |
| Southern Reef | 23 | 5 | 0 | 166 | 49 | 0 |
| **New Zealand Islands.** | | | | | | |
| Durand's Reef | 22 | 6 | 0 | 169 | 2 | 0 |
| Walpole's Island | 22 | 40 | 0 | 169 | 15 | 0 |
| Matthew's Island | 22 | 22 | 0 | 171 | 15 | 0 |
| Hunter's Island | 22 | 27 | 0 | 171 | 50 | 0 |
| New Shoal | 20 | 55 | 0 | 160 | 31 | 0 |
| Low Islands | 21 | 21 | 0 | 159 | 20 | 0 |
| Lamb's Island | 21 | 24 | 0 | 158 | 30 | 0 |
| Baring's Shoal, N. end | 20 | 40 | 0 | 158 | 40 | 0 |
| — South end | 21 | 50 | 0 | 159 | 30 | 0 |
| Booby Shoal | 21 | 0 | 0 | 159 | 6 | 0 |
| Minerva Shoal | 20 | 40 | 0 | 159 | 30 | 0 |
| Bellona Shoals | 20 | 54 | 0 | 159 | 50 | 0 |
| Ball's Rocks | 21 | 0 | 0 | 160 | 26 | 0 |
| Avon's Islands | 19 | 31 | 0 | 158 | 10 | 30 |
| Bampton's Shoal, | | | | | | |
| — Chesterfield's Bank | 19 | 51 | 0 | 158 | 20 | 0 |
| — North end | 18 | 49 | 0 | 158 | 43 | 0 |
| Kenn's Reef | 21 | 9 | 0 | 155 | 49 | 0 |
| Mellish Keys, S. end | 17 | 16 | 0 | 156 | 12 | 0 |
| Young's Reef, S. end | 17 | 17 | 0 | 155 | 20 | 0 |
| Wreck Reef, Bird I. | 22 | 11 | 28 | 155 | 18 | 50 |

| (88) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Cato's Bank | 23 | 6 | 0 | 155 | 23 | 0 |
| Midday Reef | 21 | 58 | 0 | 154 | 20 | 0 |
| Frederick's Reef, | | | | | | |
| — N. E. end | 20 | 44 | 0 | 154 | 25 | 0 |
| Saumarez Shoal | 21 | 40 | 0 | 153 | 46 | 0 |
| Welsh's Bank | 21 | 15 | 0 | 153 | 56 | 0 |
| Horseshoe Bank, | | | | | | |
| — North end | 20 | 5 | 0 | 151 | 50 | 0 |
| Alert's Reef | 17 | 2 | 0 | 151 | 49 | 0 |
| Diana's Shoal | 15 | 41 | 0 | 150 | 25 | 0 |
| Lihou's Reef | 17 | 25 | 0 | 151 | 45 | 0 |
| Farquhar's Groupe, | | | | | | |
| — West end | 17 | 39 | 0 | 151 | 27 | 0 |
| Vine's Bank | 17 | 45 | 0 | 151 | 40 | 0 |
| Tregosse Is, E. end | 17 | 44 | 0 | 150 | 32 | 0 |
| Middleton's Island | 28 | 13 | 0 | 160 | 31 | 0 |
| Middleton's Shoals | 29 | 14 | 0 | 158 | 54 | 0 |
| Golden Grove Shoal | 29 | 30 | 0 | 160 | 0 | 0 |
| Elizabeth's Reef | 30 | 5 | 0 | 159 | 0 | 0 |
| Lord Howe's Island | 31 | 26 | 0 | 159 | 0 | 0 |
| Ball's Pyramid | 31 | 43 | 0 | 159 | 5 | 0 |
| Rock | 26 | 6 | 0 | 160 | 0 | 0 |
| Island | 31 | 19 | 0 | 160 | 42 | 0 |
| Rock | 23 | 48 | 0 | 164 | 15 | 0 |
| Norfolk Island | 29 | 2 | 0 | 168 | 2 | 0 |
| *Var.* 11° 0′ *E.* | | | | | | |
| Three Kings Islands | 34 | 12 | 8 | 172 | 22 | 48 |
| Northern Island, | | | | | | |
| C. Maria Van Diemen | 34 | 29 | 49 | 172 | 48 | 58 |
| North Cape | 34 | 24 | 29 | 173 | 9 | 48 |
| Bay of Islands, | | | | | | |
| — Kororadicca | 35 | 15 | 45 | 174 | 15 | 55 |
| Bream Head | 35 | 51 | 30 | 174 | 46 | 0 |
| Cape Rodney | 36 | 20 | 26 | 174 | 56 | 0 |
| River Thames, | | | | | | |
| — Bottom, in 4 fms. | 37 | 5 | 45 | 175 | 25 | 30 |
| Cape Colville | 36 | 26 | 0 | 175 | 27 | 0 |
| Mercury Bay, anchge. | 36 | 50 | 13 | 175 | 51 | 0 |
| White Island, Volcano | 37 | 30 | 46 | 177 | 14 | 45 |
| Mount Edgecumbe | 37 | 59 | 0 | 176 | 56 | 0 |
| Cape Runaway | 37 | 32 | 0 | 177 | 52 | 0 |
| Cape East | 37 | 44 | 30 | 178 | 36 | 15 |
| Tolaga Bay | 38 | 22 | 0 | 178 | 22 | 0 |
| Young Nick's Head | 38 | 43 | 30 | 178 | 0 | 19 |
| Table Cape | 39 | 6 | 0 | 178 | 0 | 0 |
| Portland Isle | 39 | 22 | 0 | 177 | 38 | 0 |
| Cape Kidnapper | 39 | 43 | 0 | 177 | 6 | 0 |
| Cape Turnagain | 40 | 35 | 0 | 176 | 38 | 0 |
| Cape Palliser | 41 | 34 | 46 | 175 | 24 | 45 |
| Cape Tearawitte | 41 | 18 | 47 | 174 | 42 | 45 |
| Cape Egmont | 39 | 23 | 30 | 174 | 2 | 0 |
| Jokeehangar River, | | | | | | |
| — South Head | 35 | 32 | 3 | 173 | 31 | 45 |
| — North Head | 35 | 31 | 22 | 173 | 31 | 45 |
| *Var.* 13° 20′ *E.* | | | | | | |
| False Inlet | 35 | 17 | 19 | 173 | 23 | 17 |
| Southern Island, | | | | | | |
| Cape Farewell | 40 | 34 | 42 | 173 | 30 | 0 |
| Cape Stephens | 40 | 39 | 0 | 174 | 0 | 0 |
| Q. Charlotte's Sound, | | | | | | |
| — Port Jackson | 40 | 58 | 45 | 174 | 23 | 30 |

## LATITUDES AND LONGITUDES.

New Zeland Islands.

| (89) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Q. Charlotte's Sound, | | | | | | |
| — Ship Cove . . . | 41 | 5 | 56 | 174 | 13 | 0 |
| *Var.* 15° 9′ *E.* | | | | | | |
| — Cape Koamaroo . | 41 | 6 | 5 | 174 | 29 | 15 |
| Cape Campbell . . | 41 | 33 | 16 | 174 | 15 | 0 |
| Bank's Peninsula, | | | | | | |
| — South Point . . . | 43 | 52 | 15 | 173 | 0 | 0 |
| Dangerous Reef . . | 45 | 24 | 26 | 170 | 50 | 0 |
| Port Otago or Oxley . | 45 | 46 | 28 | 170 | 36 | 45 |
| Cape Saunders . . . | 45 | 53 | 55 | 170 | 33 | 30 |
| Cape West . . . . | 45 | 54 | 0 | 166 | 10 | 0 |
| Dusky Bay, | | | | | | |
| — Port Pickersgill . | 45 | 47 | 26 | 166 | 18 | 0 |
| *Var.* 13° 49′ *E.* | | | | | | |
| — Anchor I., Harbour | 45 | 44 | 15 | 166 | 15 | 54 |
| Solander Island . . | 46 | 31 | 45 | 166 | 33 | 36 |
| Stewart's Island, | | | | | | |
| — Cape South West | 47 | 16 | 37 | 167 | 14 | 30 |
| — Southern Port, | | | | | | |
| Cable Island . . | 47 | 12 | 55 | 167 | 26 | 30 |
| *Var.* 16° 54′ *E.* | | | | | | |
| Traps, North end . . | 47 | 23 | 7 | 167 | 42 | 30 |
| Snares, N. E. Island . | 48 | 3 | 48 | 166 | 20 | 15 |
| Macquarie's I., N. end | 54 | 38 | 0 | 159 | 45 | 0 |
| — Caroline Cove . . | 54 | 52 | 0 | 159 | 35 | 0 |
| *Var.* 8° 56′ *E.* | | | | | | |
| Bishop and Clerks . | 55 | 14 | 0 | 159 | 44 | 0 |
| Judge and Clerks . . | 54 | 20 | 0 | 160 | 2 | 0 |
| Royal Company's I. . | 49 | 40 | 0 | 142 | 10 | 0 |
| Ld. Auckland's Group, | | | | | | |
| — North West Cape | 50 | 31 | 0 | 166 | 0 | 0 |
| — South East Cape . | 50 | 53 | 0 | 166 | 17 | 0 |
| — Disappointment I. | 50 | 38 | 30 | 165 | 52 | 0 |
| — Endersby I., N. Pt | 50 | 32 | 30 | 166 | 28 | 0 |
| — Bristow's Rock . | 50 | 22 | 0 | 166 | 21 | 0 |
| Campbell's I., mid. . | 52 | 32 | 0 | 169 | 30 | 0 |
| *Var.* 12° 0′ *E.* | | | | | | |
| Penantipode Island . | 49 | 40 | 0 | 179 | 40 | 0 |
| Bounty Islands . . | 47 | 44 | 0 | 179 | 7 | 0 |
| Chatham Island, | | | | | West | |
| — Cape Young, N.Pt | 43 | 46 | 0 | 176 | 14 | 0 |
| — Cape Munnings, | | | | | | |
| N. E. Point . . . | 43 | 50 | 0 | 175 | 40 | 0 |
| — Point Allison, | | | | | | |
| N.W. Point . . . | 43 | 55 | 0 | 176 | 34 | 0 |
| — Skirmish Bay . . | 43 | 49 | 0 | 175 | 48 | 0 |
| *Var.* 14° 0′ *E.* | | | | | | |
| Cornwallis I., S. end | 44 | 36 | 30 | 175 | 25 | 40 |
| Nimrod's Group . . | 56 | 30 | 0 | 158 | 30 | 0 |
| | | | | | East | |
| Rosaretta Shoal . . | 30 | 10 | 0 | 173 | 45 | 0 |
| Kermadee Islands, | | | | | West | |
| — Raoul I., N.W. Pt. | 29 | 16 | 45 | 178 | 5 | 0 |
| — Macauley Island . | 30 | 16 | 0 | 178 | 32 | 0 |
| — Curtis's Islands . | 30 | 36 | 15 | 178 | 43 | 30 |
| — L'Esperance, or | | | | | | |
| Brind's Rock . . | 31 | 27 | 30 | 178 | 55 | 0 |
| Fidgee Islands, | | | | | East | |
| — Paoo I., N. Point | 16 | 16 | 0 | 179 | 0 | 0 |
| East Point . . . | 16 | 50 | 0 | 179 | 32 | 0 |

Friendly Islands.

| (90) Places. | Lat. S. | | | Lon. E. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| — Paoo Island, | | | | | | |
| Sandalwood Bay . | 16 | 30 | 0 | 178 | 30 | 0 |
| — Navihilivoo Island, | | | | | | |
| North Point . . . | 17 | 28 | 0 | 178 | 0 | 0 |
| South East Point . | 18 | 2 | 0 | 178 | 19 | 0 |
| — Mywoolla Island, | | | | | | |
| S. W. Point . . . | 19 | 10 | 0 | 178 | 5 | 0 |
| — Eliza's Reef, N. end | 18 | 0 | 0 | 179 | 20 | 0 |
| | | | | | West | |
| — Turtle Island . . | 19 | 48 | 45 | 178 | 0 | 0 |
| — Providence Reef . | 18 | 30 | 0 | 178 | 0 | 0 |
| — Duff's Reef. . . | 16 | 30 | 0 | 179 | 17 | 0 |
| — Scylla Reef. . . | 16 | 5 | 0 | 179 | 36 | 0 |
| — Farewell Island . | 15 | 42 | 0 | 179 | 35 | 0 |
| Tonga Islands, | | | | | | |
| — Ono Island . . . | 20 | 39 | 0 | 178 | 45 | 0 |
| — Coral Reef . . . | 20 | 45 | 0 | 178 | 53 | 45 |
| — Two Small Islands | 21 | 2 | 45 | 178 | 48 | 0 |
| — Pylstaart Island, | | | | | | |
| S.W. Point . . . | 22 | 24 | 45 | 175 | 57 | 0 |
| — Eoua I., English Rd. | 21 | 20 | 30 | 174 | 57 | 30 |
| — Tongataboo, Obs. . | 21 | 8 | 19 | 175 | 10 | 15 |
| — Culebra's Bank . | 20 | 21 | 0 | 175 | 16 | 0 |
| — Annamocka . . | 20 | 15 | 0 | 174 | 56 | 20 |
| — Kotou Island . . | 19 | 58 | 0 | 174 | 55 | 0 |
| — Toufoa . . . . | 19 | 46 | 0 | 175 | 10 | 0 |
| — Koa . . . . . | 19 | 42 | 0 | 175 | 8 | 0 |
| — Hapaee Islands, | | | | | | |
| Lafagoo . . . . | 19 | 51 | 0 | 174 | 27 | 0 |
| — Latté Island . . | 18 | 47 | 20 | 174 | 31 | 0 |
| — Vavao, Port Refuge | 18 | 38 | 45 | 173 | 57 | 45 |
| — Amargura . . . | 17 | 57 | 0 | 174 | 58 | 0 |
| Navigator's Islands, | | | | | | |
| — Pola or Oteewhy I., | | | | | | |
| North East Point . | 13 | 27 | 30 | 171 | 56 | 0 |
| South East Point . | 13 | 45 | 0 | 171 | 51 | 30 |
| — Mananoo or Platte I. | 13 | 51 | 15 | 171 | 47 | 40 |
| — Oahtooah or | | | | | | |
| Oyolava Island, | | | | | | |
| East Point . . . | 14 | 2 | 40 | 171 | 7 | 15 |
| — Maouna or | | | | | | |
| Tootooillah Island, | | | | | | |
| West Point . . . | 14 | 20 | 51 | 170 | 20 | 0 |
| Massacre Bay . . | 14 | 20 | 45 | 170 | 17 | 0 |
| — Tabootaboo . . . | 14 | 21 | 0 | 170 | 2 | 0 |
| — Fanfoué, E. Point | 14 | 5 | 20 | 169 | 18 | 30 |
| — Leonéor Olooshonga | 14 | 7 | 50 | 169 | 16 | 20 |
| — Opoun, E. Point . | 14 | 9 | 10 | 169 | 9 | 50 |
| — Rose or Kordiucoff | | | | | | |
| Island . . . . . | 14 | 33 | 0 | 168 | 5 | 51 |
| Rotumah Island . . | 12 | 31 | 0 | 177 | 15 | E |
| Onascuse or Hunter's | | | | | West | |
| Island . . . . . | 15 | 31 | 0 | 176 | 11 | 0 |
| Horne Islands . . . | 14 | 18 | 0 | 178 | 18 | 0 |
| Enfans Perdu . . . | 14 | 21 | 0 | 176 | 40 | 0 |
| Wallis' Island . . . | 13 | 26 | 0 | 176 | 50 | 0 |
| Boscawen Island . . | 15 | 50 | 0 | 174 | 7 | 0 |
| Keppel's Island . . | 15 | 56 | 30 | 174 | 10 | 24 |
| Onookfou or Proby I.. | 15 | 53 | 0 | 175 | 51 | 0 |
| | | | | | East | |
| Charlotte's Bank . . | 11 | 50 | 0 | 178 | 12 | 0 |

## LATITUDES AND LONGITUDES.

| (91) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Solitary Island | 10 | 46 | 0 | 174 | 43 | 0 |
| Independence or Ganges Island | 10 | 25 | 0 | 179 | East 0 | 0 |
| Mitchell's Groupe, — Plaskett Island | 9 | 18 | 0 | 179 | 50 | 0 |
| Ellice's Group, — Escape Island | 8 | 29 | 5 | 179 | 6 | 0 |
| De Peyster's Groupe, — South end | 8 | 5 | 0 | 178 | 17 | 0 |
| Netherland Island | 7 | 7 | 0 | 177 | 33 | 0 |
| Island | 7 | 25 | 0 | 179 | 28 | 0 |
| Larose Island, S. end | 7 | 19 | 0 | 176 | 55 | 0 |
| Egg Islands | 7 | 10 | 0 | 177 | 10 | 0 |
| Sherson's or Cocal I. | 6 | 1 | 48 | 176 | 27 | 3 |
| Taswell's or Saint Augustine Island | 5 | 38 | 0 | 176 | 9 | 50 |
| Hope or Hurd Island | 2 | 50 | 0 | 177 | 0 | 0 |
| Jesus Island | 6 | 45 | 0 | 171 | 30 | 0 |
| Mattoelee or Kennedy Island | 8 | 40 | 0 | 168 | 0 | 0 |
| Shank's Island ? | 0 | 25 | 0 | 163 | 0 | 0 |
| Pleasant Island | 0 | 25 | 0 | 167 | 10 | 0 |
| Ocean Island | 0 | 48 | 0 | 169 | 49 | 0 |
| Doubtful Island | 3 | 10 | 0 | 170 | 0 | 0 |
| Rotche's Island | 2 | 32 | 0 | 176 | 9 | 0 |
| Eliza's Island | 2 | 5 | 0 | 176 | 0 | 0 |
| Arthur's Island | 3 | 30 | 0 | 176 | 0 | 0 |
| Island | 2 | 50 | 0 | 179 | 18 | 0 |
| Kemin Island | 4 | 45 | 0 | 173 | West 40 | 0 |
| Rock | 5 | 38 | 0 | 172 | 53 | 45 |
| Island | 3 | 41 | 0 | 172 | 52 | 0 |
| Gardner's Island | 4 | 30 | 0 | 174 | 22 | 0 |
| Mary Letitia's Rock | 4 | 46 | 0 | 173 | 19 | 0 |
| Dangerous Reef | 5 | 38 | 0 | 173 | 33 | 0 |
| Elizabeth's Island | 4 | 27 | 0 | 172 | 21 | 0 |
| Sidney's Islands | 4 | 28 | 0 | 171 | 24 | 0 |
| Phenix Island | 3 | 35 | 0 | 170 | 40 | 0 |
| Burney's Island | 3 | 30 | 0 | 171 | 20 | 0 |
| Mary's Island | 2 | 45 | 0 | 172 | 0 | 0 |
| Enderby's Island | 3 | 6 | 0 | 171 | 11 | 0 |
| Farmer's Island | 2 | 53 | 0 | 170 | 46 | 0 |
| D. of York's Island | 8 | 33 | 0 | 172 | 0 | 0 |
| Duke of Clarence's I. | 9 | 12 | 0 | 171 | 30 | 0 |
| Quiros Island ? | 10 | 40 | 0 | 170 | 6 | 0 |
| Island | 6 | 34 | 0 | 166 | 30 | 0 |
| Rock | 10 | 46 | 0 | 166 | 6 | 0 |
| Danger Islands | 10 | 15 | 0 | 165 | 58 | 0 |
| Suwarrow Islands | 13 | 20 | 0 | 163 | 30 | 0 |
| Reirson's Island | 10 | 6 | 0 | 160 | 55 | 0 |
| Humphrey's Island | 10 | 33 | 0 | 161 | 0 | 0 |
| Bennett's Island | 8 | 54 | 0 | 159 | 45 | 0 |
| Jarvis's Island | 0 | 24 | 0 | 159 | 58 | 0 |
| Piscado Island | 10 | 36 | 0 | 159 | 25 | 0 |
| Penrhyn's Islands *Var.* 8° 28′ *E.* | 9 | 1 | 30 | 157 | 34 | 30 |
| Starve Island | 5 | 43 | 0 | 156 | 30 | 0 |
| Starbuck Island | 5 | 58 | 30 | 155 | 58 | 0 |
| Maldon Island | 5 | 26 | 0 | 155 | 50 | 0 |
| Independance Island | 4 | 10 | 0 | 154 | 30 | 0 |
| Bunker's Rock | 0 | 17 | 0 | 160 | 40 | 0 |
| Broke Island | 1 | 13 | 0 | 159 | 30 | 0 |

| (92) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Island | 6 | 45 | 0 | 160 | 48 | 0 |
| Bauman's Islands | 11 | 54 | 0 | 155 | 10 | 0 |
| Flint's Island | 10 | 30 | 0 | 152 | 0 | 0 |
| Staver's Island | 10 | 4 | 0 | 151 | 50 | 0 |
| Caroline's Island | 9 | 57 | 0 | 150 | 25 | 0 |
| Vasquez Island | 24 | 44 | 0 | 175 | 18 | 0 |
| Savage Island | 19 | 1 | 0 | 169 | 37 | 0 |
| Beveridge Reef | 19 | 56 | 0 | 167 | 30 | 0 |
| Palmerston Island | 18 | 4 | 0 | 163 | 10 | 0 |
| Cook's Islands, — Whylootacke | 18 | 54 | 0 | 159 | 41 | 0 |
| — Hervey's Island | 19 | 18 | 0 | 158 | 54 | 0 |
| — Okatoolaiai Island | 19 | 51 | 0 | 158 | 23 | 0 |
| — Mittiaro Island | 19 | 55 | 0 | 157 | 54 | 0 |
| — Wateeo Island | 20 | 1 | 0 | 158 | 15 | 0 |
| — Mawti Island | 20 | 8 | 0 | 157 | 20 | 0 |
| — Mahowara Island | 20 | 15 | 0 | 157 | 57 | 0 |
| — Rorotonga or Ororute Island | 21 | 30 | 0 | 160 | 0 | 0 |
| — Roxburgh Island | 21 | 36 | 0 | 159 | 18 | 0 |
| — Mongeea Island | 21 | 57 | 0 | 158 | 7 | 0 |
| Island | 26 | 0 | 0 | 160 | 59 | 0 |
| Bellinghausen's Island | 15 | 48 | 0 | 154 | 30 | 0 |
| Scilly Islands | 16 | 28 | 0 | 155 | 30 | 0 |
| Mopeelia Island | 16 | 46 | 0 | 154 | 8 | 0 |
| Tabae Island, N. Pt. | 16 | 11 | 0 | 151 | 48 | 0 |
| Maurua Island | 16 | 25 | 0 | 152 | 8 | 20 |
| Bolabola Island | 16 | 27 | 0 | 151 | 46 | 20 |
| Otaha Island | 16 | 35 | 0 | 151 | 35 | 0 |
| Ulieta Island, — Port Ohamaneno | 16 | 45 | 32 | 151 | 36 | 20 |
| Huahene Island, — Port Owharre | 16 | 42 | 49 | 151 | 7 | 36 |
| Saunders Island | 17 | 28 | 0 | 150 | 30 | 50 |
| Eimeo Island, — Port Talou | 17 | 30 | 0 | 150 | 0 | 0 |
| Otaheite Island, — Point Venus | 17 | 29 | 12 | 149 | 28 | 46 |
| *Var.* 6° 50′ *E.* | | | | | | |
| — Oiatipeha Hr. | 17 | 46 | 28 | 149 | 7 | 20 |
| Tethuroa Island | 17 | 6 | 0 | 149 | 33 | 35 |
| Maitea or Osnaberg Island | 17 | 49 | 10 | 148 | 3 | 20 |
| Peregrino Island | 14 | 42 | 0 | 151 | 42 | 0 |
| Fugitive Island | 15 | 30 | 0 | 150 | 52 | 0 |
| Recreation Island | 15 | 31 | 0 | 150 | 0 | 0 |
| Lazaroff Island | 14 | 56 | 0 | 149 | 10 | 0 |
| Krusenstern's Islands | 15 | 0 | 0 | 148 | 45 | 36 |
| Matia Island | 15 | 52 | 30 | 148 | 18 | 30 |
| Deans Islands, W. end | 15 | 0 | 0 | 148 | 27 | 30 |
| — East End | 15 | 16 | 30 | 147 | 12 | 0 |
| Labyrinth Island | 15 | 38 | 0 | 148 | 31 | 0 |
| Rurick's Is., W. end | 15 | 20 | 0 | 146 | 57 | 0 |
| — East End | 15 | 20 | 0 | 146 | 35 | 30 |
| King George's Islands — Twokea | 14 | 37 | 0 | 145 | 15 | 30 |
| — Oura | 14 | 41 | 0 | 145 | 5 | 25 |
| Romanzoff Island | 14 | 57 | 30 | 144 | 28 | 30 |
| Carlshoff Island | 15 | 27 | 0 | 145 | 31 | 12 |
| Elizabeth Island | 15 | 56 | 0 | 146 | 0 | 0 |

*Society Islands.*

*Low Islands.*

## LATITUDES AND LONGITUDES.

| (93) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Low Islands.* | | | | | | |
| Palliser Island | 15 | 34 | 25 | 146 | 6 | 50 |
| Two Small Islands | 15 | 30 | 0 | 146 | 20 | 50 |
| Greig's Island | 16 | 11 | 0 | 146 | 22 | 0 |
| Wittgenstein Islands, — North end | 16 | 1 | 0 | 145 | 39 | 0 |
| Myloradowitch Island, — North end | 16 | 42 | 0 | 145 | 19 | 0 |
| Tchitchagoff Islands, — West end | 16 | 52 | 0 | 144 | 58 | 0 |
| Sackin I., S. E. end | 16 | 31 | 0 | 144 | 12 | 0 |
| Adventure or Guarava Island | 17 | 4 | 0 | 144 | 30 | 0 |
| Chain Island | 17 | 26 | 0 | 145 | 38 | 0 |
| Philip's Island | 16 | 34 | 0 | 143 | 57 | 0 |
| Koutousoff Island | 16 | 36 | 0 | 143 | 45 | 30 |
| Jermoeloff or Holt's I. | 16 | 21 | 45 | 143 | 9 | 20 |
| Fourneaux Island | 17 | 5 | 0 | 143 | 16 | 0 |
| St. Quintin's Island | 17 | 20 | 0 | 143 | 48 | 0 |
| Bird Island | 17 | 48 | 0 | 143 | 10 | 0 |
| Bunyer's Group | 18 | 12 | 0 | 143 | 20 | 0 |
| Wolchonsky Island | 15 | 52 | 0 | 142 | 14 | 0 |
| Barclay de Tolly I. | 16 | 13 | 0 | 142 | 29 | 0 |
| Nigeri Island | 17 | 42 | 0 | 142 | 48 | 0 |
| Doubtful Island | 17 | 20 | 0 | 142 | 38 | 0 |
| Two Groups | 18 | 12 | 0 | 142 | 17 | 0 |
| Lostange I., E. Point | 18 | 43 | 0 | 141 | 48 | 45 |
| Pr. Wm. Henry's I. | 19 | 13 | 50 | 141 | 17 | 0 |
| Resolution Island | 17 | 24 | 0 | 141 | 39 | 0 |
| Disappointment Is. | 14 | 6 | 0 | 140 | 58 | 0 |
| Dogs Island | 14 | 50 | 0 | 138 | 52 | 30 |
| Arackchiff Island | 15 | 51 | 0 | 140 | 52 | 0 |
| Enterprize or Predpriatre Island | 15 | 58 | 15 | 140 | 11 | 30 |
| *Dangerous Archipelago.* | | | | | | |
| Moller or Freycinet's Island, — North East Point | 17 | 48 | 0 | 140 | 37 | 0 |
| Bow Island | 18 | 23 | 0 | 140 | 47 | 0 |
| Glocester Island | 19 | 11 | 0 | 140 | 15 | 0 |
| Cumberland Island | 19 | 18 | 0 | 140 | 47 | 0 |
| Narcissus Island | 17 | 25 | 0 | 139 | 15 | 0 |
| Island | 16 | 0 | 0 | 139 | 0 | 0 |
| David Clerk's Island | 17 | 19 | 0 | 138 | 30 | 0 |
| Thrum Cap Island | 18 | 35 | 0 | 139 | 23 | 0 |
| Lagoon Island | 18 | 46 | 0 | 139 | 3 | 0 |
| Egmont Island | 19 | 20 | 0 | 138 | 41 | 0 |
| Q Charlotte's Island | 19 | 16 | 0 | 138 | 15 | 0 |
| Whitsun or Trinity I. | 19 | 26 | 0 | 138 | 7 | 0 |
| Island | 17 | 0 | 0 | 138 | 0 | 0 |
| Serle's I., N. W. Pt. | 18 | 18 | 15 | 136 | 58 | 15 |
| Minerva Island | 18 | 22 | 0 | 136 | 45 | 0 |
| Tonnere I., S. E. Pt. | 18 | 33 | 0 | 136 | 14 | 0 |
| Remitara Island | 22 | 43 | 0 | 152 | 3 | 0 |
| Ohetiroa Island | 22 | 27 | 0 | 150 | 46 | 45 |
| Toobouai Island | 23 | 25 | 0 | 149 | 23 | 0 |
| Vavitoo Island | 23 | 42 | 0 | 147 | 11 | 0 |
| Oparo Island | 27 | 36 | 0 | 144 | 8 | 32 |
| Bass Islands | 27 | 40 | 0 | 143 | 30 | 0 |
| Glocester Islands | 20 | 38 | 0 | 143 | 7 | 30 |
| Surrey Island | 19 | 56 | 0 | 145 | 6 | 0 |
| St. Elmo Island | 21 | 20 | 0 | 143 | 50 | 0 |
| St. Michael's Island | 20 | 9 | 0 | 144 | 0 | 0 |

| (94) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| St. Paul's Island | 19 | 40 | 0 | 145 | 0 | 0 |
| Margaret's Island | 20 | 26 | 0 | 143 | 24 | 0 |
| Lagoon Island | 21 | 40 | 0 | 140 | 30 | 0 |
| Carysfort Island | 20 | 49 | 0 | 138 | 33 | 0 |
| Osnaburg Island | 22 | 0 | 0 | 138 | 34 | 0 |
| Duff's or High Island | 20 | 30 | 0 | 136 | 40 | 0 |
| Lord Hood's Islands | 21 | 36 | 0 | 135 | 27 | 0 |
| Gambier's Islands | 23 | 12 | 0 | 135 | 0 | 0 |
| Crescent Island | 23 | 21 | 30 | 134 | 30 | 0 |
| *Mendana Islands.* | | | | | | |
| Washington Islands, — Fattouhou Island, N. E. Point | 7 | 50 | 0 | 140 | 6 | 0 |
| — Hiaou I., S. Point | 7 | 59 | 0 | 140 | 13 | 0 |
| — Mottuaity Island | 8 | 37 | 30 | 140 | 20 | 0 |
| — Noukahua Island, Point Martin | 8 | 57 | 0 | 139 | 32 | 30 |
| Point Anna Maria | 8 | 55 | 30 | 139 | 30 | 45 |
| Point Tchitchagoff | 8 | 57 | 0 | 139 | 42 | 15 |
| — Ouahouga or Washington Island, South Point | 8 | 58 | 15 | 139 | 13 | 0 |
| — Ouapoa I., N. Pt. | 9 | 21 | 30 | 139 | 39 | 0 |
| — Lincoln Island | 9 | 29 | 30 | 139 | 33 | 30 |
| Marquesas, — Tetugoa Island | 9 | 24 | 30 | 138 | 29 | 30 |
| — Ohevahoa I., W. Pt. | 9 | 44 | 0 | 138 | 51 | 0 |
| East Point | 9 | 42 | 0 | 138 | 32 | 0 |
| — Taowatte Island, Resolution Bay | 9 | 55 | 30 | 138 | 50 | 10 |
| — Motane Island | 9 | 57 | 0 | 138 | 32 | 0 |
| — Ohitaheooh or Magdalen Island | 10 | 25 | 0 | 138 | 28 | 0 |
| St. Juan Baptista I. | 24 | 0 | 0 | 139 | 0 | 0 |
| Incarnation Island | 24 | 45 | 0 | 136 | 40 | 0 |
| Martha's Island | 24 | 3 | 0 | 131 | 20 | 0 |
| Oeno or Bond's Island | 23 | 57 | 0 | 131 | 5 | 0 |
| Pitcairn's Island | 25 | 4 | 0 | 130 | 25 | 0 |
| Henderson's Island | 24 | 21 | 0 | 128 | 30 | 0 |
| Elizabeth's Island | 24 | 26 | 0 | 127 | 50 | 0 |
| Ducie's Low Island | 24 | 36 | 0 | 124 | 36 | 0 |
| Easter I., Cook's Bay | 27 | 9 | 30 | 109 | 25 | 20 |
| Salas y Gomez Island | 26 | 26 | 15 | 105 | 34 | 30 |
| Pilgrim's Island | 24 | 40 | 0 | 104 | 40 | 0 |
| St. Felix Island | 26 | 20 | 15 | 80 | 10 | 0 |
| Ambrose Island | 26 | 20 | 0 | 79 | 51 | 0 |
| *Var.* 11° 30′ *E.* | | | | | | |
| Juan Fernandez Is., — Afuera | 33 | 49 | 0 | 80 | 34 | 0 |
| — Tierra, S. W. Point | 33 | 45 | 0 | 78 | 51 | 43 |
| Peter the 1st Island | 69 | 25 | 0 | 90 | 0 | 0 |
| Alexander the 1st I. | 69 | 30 | 0 | 75 | 0 | 0 |

### XXIII. The WEST COAST of AMERICA from CAPE HORN to ICY CAPE.

| | | | | | | |
|---|---|---|---|---|---|---|
| Cape Horn | 55 | 58 | 30 | 67 | 21 | 15 |
| *Var.* 22° 30′ *E.* | | | | | | |
| Diego Ramirez Is. | 56 | 27 | 0 | 68 | 39 | 0 |
| St. Ildefonso Islands | 55 | 51 | 0 | 69 | 15 | 30 |

## LATITUDES AND LONGITUDES.

| | (95) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| T. del Fuego. | Christmas Sound, | | | | | | |
| | — York Minster | 55 | 26 | 0 | 70 | 8 | 0 |
| | Gilbert Is., center | 55 | 13 | 30 | 70 | 56 | 0 |
| | Cape Desolation | 54 | 55 | 0 | 71 | 43 | 0 |
| | Cape Noir or Negro | 54 | 31 | 30 | 73 | 16 | 15 |
| | Cape Gloucester | 54 | 7 | 0 | 73 | 36 | 0 |
| | Cape Pilar | 52 | 46 | 0 | 74 | 54 | 15 |
| | The Evangelists | 52 | 34 | 0 | 75 | 6 | 0 |
| | Cape Victory | 52 | 23 | 0 | 74 | 56 | 0 |
| | Cape Sta. Lucea | 51 | 25 | 0 | 75 | 31 | 0 |
| | Cape St. Jago | 50 | 54 | 0 | 75 | 32 | 0 |
| | *Var.* 21° 30′ *E.* | | | | | | |
| | Cape Three Points | 49 | 46 | 0 | 75 | 46 | 15 |
| | Cape Corso | 49 | 26 | 0 | 75 | 46 | 0 |
| | Guayanceo Is. N. Pt. | 47 | 32 | 0 | 75 | 5 | 0 |
| | Cape Tres Montes | 46 | 59 | 0 | 75 | 28 | 0 |
| | Lemus I., N. Point | 45 | 6 | 0 | 74 | 47 | 0 |
| | Guaytecas Is., W. Pt. | 44 | 25 | 0 | 74 | 0 | 0 |
| | Guafo Island, middle | 44 | 1 | 0 | 74 | 39 | 0 |
| | Chiloe Island, | | | | | | |
| | — Point Quelan | 43 | 41 | 0 | 74 | 19 | 30 |
| | *Var.* 16° *E.* | | | | | | |
| | — Castro | 42 | 41 | 0 | 73 | 36 | 0 |
| | — St. Carlos, Fort | 41 | 51 | 50 | 73 | 53 | 50 |
| | Point Quedal | 41 | 5 | 0 | 74 | 5 | 0 |
| | Valdivia, Fort | 39 | 50 | 7 | 73 | 34 | 35 |
| | Mocha I., middle | 38 | 20 | 0 | 74 | 5 | 0 |
| | Sta Maria I. N.W. Pt. | 37 | 1 | 0 | 73 | 41 | 0 |
| | Arauco | 37 | 14 | 30 | 73 | 28 | 30 |
| | Conception, City | 36 | 49 | 10 | 73 | 4 | 45 |
| | Port Conception, | | | | | | |
| | — Talcahuano | 36 | 42 | 32 | 73 | 8 | 0 |
| | *Var.* 15° 30′ *E.* | | | | | | |
| | Itata River, entrance | 35 | 58 | 0 | 72 | 52 | 0 |
| | Topocalma Shoal, mid. | 33 | 55 | 0 | 71 | 56 | 20 |
| | St. Jago, City | 33 | 26 | 30 | 70 | 44 | 0 |
| | Valparaiso, | | | | | | |
| | — Rosario Castle | 33 | 1 | 55 | 71 | 40 | 25 |
| | *Var.* 14° 43′ *E.* | | | | | | |
| | Rio Limari, entrance | 30 | 45 | 0 | 71 | 52 | 0 |
| | Punta de Lengua de | | | | | | |
| | Baca | 30 | 16 | 30 | 71 | 46 | 0 |
| | Port Coquimbo, | | | | | | |
| | — La Serena, Church | 29 | 53 | 43 | 71 | 18 | 40 |
| | Canaveral Island | 29 | 2 | 0 | 71 | 39 | 0 |
| | Port Guasco, Outer | | | | | | |
| | Rock | 28 | 27 | 0 | 71 | 14 | 0 |
| | *Var.* 13° 30′ *E.* | | | | | | |
| | Copiapo, Hill | 27 | 12 | 0 | 71 | 6 | 0 |
| | Nostra Senora Bay, | | | | | | |
| | — North Point | 25 | 12 | 0 | 70 | 48 | 0 |
| | George's Hill | 23 | 31 | 0 | 70 | 34 | 0 |
| | Mexillones Hill | 23 | 3 | 0 | 70 | 27 | 0 |
| | Cobija | 22 | 29 | 30 | 70 | 6 | 0 |
| | Tarapaca Hill | 20 | 17 | 0 | 70 | 17 | 0 |
| | Iquique Island | 20 | 13 | 15 | 70 | 13 | 0 |
| | Pesagua Point | 19 | 27 | 0 | 70 | 19 | 0 |
| | Arica, St. Mark | 18 | 28 | 35 | 70 | 16 | 0 |
| | *Var.* 10° 25′ *E.* | | | | | | |
| | Ilo | 17 | 36 | 15 | 71 | 19 | 0 |
| | Mollendo | 17 | 2 | 15 | 71 | 54 | 0 |
| | Port Ilay | 17 | 1 | 0 | 72 | 0 | 15 |

| | (96) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Coast of Peru. | Quilca | 16 | 41 | 50 | 72 | 27 | 15 |
| | Pescadores | 16 | 15 | 10 | 73 | 33 | 51 |
| | Port Caballos, | | | | | | |
| | — Point Nasca | 14 | 58 | 50 | 75 | 23 | 57 |
| | Infernal Rock | 14 | 42 | 5 | 75 | 44 | 33 |
| | Mercedes Hill | 14 | 35 | 29 | 76 | 3 | 48 |
| | Los Amigos | 14 | 20 | 0 | 76 | 7 | 16 |
| | Sangallan Island | 13 | 50 | 0 | 76 | 25 | 0 |
| | Pisco | 13 | 44 | 0 | 76 | 13 | 0 |
| | Canete, Point Frayle | 13 | 3 | 0 | 76 | 31 | 0 |
| | Chilca Point | 12 | 33 | 0 | 76 | 46 | 0 |
| | Morro Solar | 12 | 12 | 0 | 76 | 59 | 0 |
| | Lorenzo I., N. Point | 12 | 4 | 0 | 77 | 12 | 0 |
| | Callao, Castle | 12 | 3 | 45 | 77 | 6 | 10 |
| | *Var.* 10° 34′ *E.* | | | | | | |
| | Lima, City | 12 | 2 | 34 | 76 | 58 | 45 |
| | The Hormigas or Ants | 11 | 55 | 48 | 77 | 51 | 17 |
| | Pescador Island | 11 | 46 | 0 | 77 | 12 | 30 |
| | Huauca Point | 11 | 19 | 0 | 77 | 30 | 0 |
| | Patibilca, Road | 10 | 51 | 0 | 77 | 32 | 0 |
| | Guarmay R., entr. | 10 | 4 | 0 | 78 | 6 | 0 |
| | Santa Island | 9 | 1 | 30 | 78 | 36 | 0 |
| | Guanape Island | 8 | 36 | 0 | 78 | 55 | 0 |
| | Truxillo | 8 | 6 | 0 | 78 | 56 | 0 |
| | La Campana Hill | 7 | 57 | 30 | 79 | 0 | 0 |
| | Malabrigo Point | 7 | 45 | 30 | 79 | 19 | 0 |
| | Pacasmayo Point | 7 | 28 | 40 | 79 | 28 | 0 |
| | Cherrepe Hill | 7 | 11 | 40 | 79 | 29 | 0 |
| | Eten Hill | 6 | 56 | 10 | 79 | 45 | 0 |
| | Lobos de Afuera | 7 | 3 | 0 | 80 | 41 | 0 |
| | Lobos de Tierra | 6 | 30 | 0 | 80 | 48 | 0 |
| | Aguja Point | 5 | 59 | 20 | 81 | 4 | 0 |
| | Piura River | 5 | 33 | 0 | 80 | 48 | 0 |
| | Payta Point | 5 | 3 | 30 | 81 | 2 | 0 |
| | Parina Point | 4 | 42 | 30 | 81 | 11 | 0 |
| | Cape Blanco | 4 | 19 | 30 | 81 | 7 | 0 |
| | Picos Point | 3 | 45 | 10 | 80 | 36 | 30 |
| | St. Clara Island | 3 | 13 | 42 | 80 | 14 | 33 |
| | Point Salinas | 3 | 4 | 0 | 80 | 8 | 0 |
| | Guayaquil | 2 | 12 | 12 | 79 | 39 | 46 |
| | *Var.* 9° 5′ *E.* | | | | | | |
| | St. Elena Point | 2 | 11 | 0 | 80 | 48 | 0 |
| | Salango Island | 1 | 38 | 0 | 80 | 41 | 0 |
| | Island de la Plata | 1 | 18 | 45 | 80 | 56 | 0 |
| | Cape St. Lorenzo | 1 | 4 | 0 | 80 | 43 | 0 |
| | Cape Pasado | 0 | 23 | 0 | 80 | 20 | 0 |
| | Quito, City | 0 | 13 | 17 | 78 | 21 | 30 |
| | | | | | North | | |
| | Cape St. Francisco | 0 | 39 | 0 | 79 | 52 | 0 |
| | Galera Point | 0 | 48 | 0 | 79 | 56 | 45 |
| | Esmeraldas | 0 | 54 | 0 | 79 | 23 | 0 |
| | Point Mangles | 1 | 36 | 30 | 78 | 50 | 30 |
| | Tumaco Island | 1 | 47 | 0 | 78 | 38 | 0 |
| | Gallo Island | 1 | 57 | 0 | 78 | 31 | 0 |
| | Point Guascama | 2 | 29 | 0 | 78 | 21 | 0 |
| | Gorgona Island | 2 | 52 | 30 | 78 | 4 | 0 |
| | Buenaventura Bay | 3 | 50 | 0 | 76 | 55 | 0 |
| | Magdalena Bay | 3 | 56 | 0 | 77 | 5 | 0 |
| | Chirambira Point | 4 | 14 | 30 | 77 | 15 | 0 |
| | Cerro de Baudo | 4 | 49 | 0 | 76 | 56 | 0 |
| | Cape Corrientes | 5 | 34 | 0 | 77 | 16 | 0 |
| | St. Francisco Solano Pt. | 6 | 48 | 30 | 77 | 48 | 30 |

# TABLE LVI.

## LATITUDES AND LONGITUDES.

| (97) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Quemado Hill | 7 | 18 | 0 | 77 | 50 | 0 |
| Port Penas | 7 | 32 | 0 | 77 | 52 | 0 |
| Garachiné Point | 8 | 6 | 30 | 78 | 10 | 15 |
| Isla del Rey, | | | | | | |
| — Cocos or S. Point | 8 | 13 | 0 | 78 | 40 | 0 |
| PANAMA, City | 8 | 57 | 30 | 79 | 18 | 30 |
| *Var.* 7° 0′ *E.* | | | | | | |
| Chamé Point | 8 | 38 | 35 | 79 | 28 | 30 |
| Point Mala | 7 | 25 | 0 | 79 | 54 | 0 |
| Point Mariato | 7 | 14 | 0 | 80 | 36 | 0 |
| Quicara Islands, S.end | 7 | 10 | 0 | 81 | 40 | 0 |
| Quibo Isle, | | | | | | |
| — Port Damas | 7 | 26 | 0 | 81 | 31 | 0 |
| Burica Point | 8 | 1 | 0 | 82 | 50 | 0 |
| Cape Blanco | 9 | 30 | 0 | 84 | 35 | 0 |
| Mount Hermosa | 10 | 11 | 0 | 85 | 25 | 0 |
| Port Culebra, entr. | 10 | 42 | 0 | 85 | 37 | 0 |
| St. Catalina Point | 10 | 54 | 0 | 85 | 47 | 0 |
| Leon | 12 | 20 | 0 | 86 | 45 | 0 |
| Realejo | 12 | 29 | 50 | 87 | 6 | 30 |
| Point Remedios | 13 | 30 | 0 | 89 | 40 | 0 |
| Nuevo Guatemala | 14 | 7 | 0 | 91 | 20 | 0 |
| Barra de Soconusco | 15 | 35 | 0 | 93 | 22 | 0 |
| Tchuantepic | 16 | 13 | 0 | 95 | 24 | 0 |
| Palizada or Acamama | 16 | 33 | 0 | 98 | 54 | 0 |
| Acapulco, Fort | 16 | 50 | 29 | 99 | 53 | 47 |
| *Var.* 8° 40′ *E.* | | | | | | |
| Tetas de Telupan, abt | 18 | 18 | 0 | 103 | 20 | 0 |
| Cape Corrientes | 20 | 24 | 32 | 105 | 42 | 26 |
| Piedra Island | 20 | 43 | 0 | 105 | 51 | 4 |
| St. Blas | 21 | 32 | 24 | 105 | 18 | 27 |
| Piedra Blanca | 21 | 34 | 48 | 105 | 32 | 7 |
| Tres Marias Islands, | | | | | | |
| — South Island | 21 | 19 | 22 | 106 | 15 | 40 |
| — St. Juanito Island | 21 | 45 | 0 | 106 | 42 | 17 |
| Isabella Island | 21 | 51 | 15 | 105 | 55 | 47 |
| Gulf of California, | | | | | | |
| — R. Mazatlan, entr. | 23 | 10 | 30 | 106 | 35 | 0 |
| — Port Guaymas | 27 | 53 | 41 | 110 | 47 | 15 |
| — Espirito Santo I. | 24 | 35 | 0 | 109 | 58 | 0 |
| — Cape del Palmo | 23 | 23 | 0 | 109 | 15 | 0 |
| — Cape San Lucas | 22 | 52 | 28 | 109 | 50 | 23 |
| Todos los Santos | 23 | 26 | 0 | 110 | 16 | 48 |
| Morro Hermosa | 27 | 46 | 0 | 114 | 41 | 0 |
| Redondo Island | 29 | 49 | 0 | 115 | 10 | 0 |
| Bay St. Francisco | 30 | 23 | 0 | 115 | 36 | 0 |
| Todos Santos Bay | 31 | 56 | 0 | 116 | 22 | 0 |
| Port Diego | 32 | 42 | 30 | 116 | 53 | 15 |
| Point Conception | 34 | 32 | 0 | 120 | 6 | 0 |
| Monterey | 36 | 36 | 24 | 121 | 51 | 46 |
| Port St. Francisco | 37 | 48 | 30 | 122 | 27 | 23 |
| Cape Mendocino | 40 | 29 | 0 | 124 | 29 | 0 |
| Port Trinidad | 41 | 3 | 0 | 124 | 0 | 0 |
| Cape Blanco or | | | | | | |
| Orford | 42 | 52 | 0 | 124 | 25 | 0 |
| Cape Gregory | 43 | 29 | 0 | 124 | 9 | 0 |
| Cape Perpetua | 44 | 12 | 0 | 123 | 55 | 0 |
| Cape Foulweather | 44 | 49 | 0 | 123 | 56 | 0 |
| Cape Lookout | 45 | 32 | 0 | 123 | 49 | 0 |
| Colombia River, | | | | | | |
| — C. Disappointment | 46 | 19 | 0 | 123 | 54 | 0 |
| *Var.* 20° 0′ *E.* | | | | | | |

*Central America.*

| (98) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Gray's Harbour | 47 | 0 | 0 | 123 | 53 | 0 |
| Point Grenville | 47 | 22 | 0 | 124 | 1 | 30 |
| Cape Flattery | 48 | 23 | 30 | 124 | 22 | 0 |
| Port St. Juan | 48 | 34 | 0 | 124 | 8 | 0 |
| Nootka Sound | 49 | 34 | 20 | 126 | 28 | 30 |
| Woody Point | 50 | 6 | 0 | 127 | 43 | 0 |
| Cape Scott | 50 | 48 | 0 | 128 | 20 | 0 |
| Scott's or Sartine's | | | | | | |
| Islands | 50 | 52 | 0 | 129 | 0 | 0 |
| Point Chatham | 50 | 19 | 30 | 125 | 15 | 0 |
| Pta. de Gonzalo | 48 | 28 | 0 | 122 | 53 | 0 |
| Cape Caution | 51 | 12 | 0 | 127 | 51 | 0 |
| Cape Swaine | 52 | 13 | 0 | 128 | 20 | 0 |
| Calamity Harbour | 53 | 10 | 30 | 129 | 34 | 0 |
| Cape Ibbetson | 54 | 4 | 0 | 130 | 30 | 0 |
| Brown's Passage | 54 | 20 | 0 | 130 | 32 | 0 |
| Cape de Chacon | 54 | 43 | 0 | 131 | 45 | 0 |
| Cape de Muzon | 54 | 42 | 30 | 132 | 31 | 0 |
| Cape St. James or | | | | | | |
| Hector | 51 | 57 | 30 | 131 | 6 | 0 |
| Cape Henry | 52 | 53 | 0 | 132 | 14 | 30 |
| Mawko | 53 | 2 | 0 | 132 | 5 | 0 |
| Point Buck | 53 | 10 | 0 | 132 | 40 | 0 |
| Point Hunter | 53 | 19 | 0 | 132 | 47 | 0 |
| Langara or | | | | | | |
| North Island | 54 | 20 | 0 | 133 | 2 | 30 |
| Point Estrado | 54 | 12 | 0 | 131 | 5 | 0 |
| Forrester's or | | | | | | |
| St. Carlos Island, | | | | | | |
| — North Point | 54 | 53 | 0 | 133 | 21 | 0 |
| Point Bucarelli | 55 | 12 | 0 | 133 | 25 | 0 |
| Cape Addington | 55 | 26 | 45 | 133 | 37 | 30 |
| Cape Pole | 55 | 58 | 20 | 133 | 33 | 0 |
| Cape Decision | 56 | 2 | 0 | 133 | 52 | 0 |
| Hazy Islands | 55 | 54 | 0 | 134 | 18 | 0 |
| Cape Ommaney | 56 | 10 | 0 | 134 | 23 | 30 |
| Norfolk Sound, | | | | | | |
| — Cape Edgecumbe | 57 | 2 | 0 | 135 | 34 | 30 |
| Cape Cross | 57 | 55 | 30 | 136 | 17 | 0 |
| *Var.* 30° *E.* | | | | | | |
| Cape Spencer | 58 | 12 | 30 | 136 | 24 | 20 |
| Cape Fairweather | 58 | 50 | 40 | 137 | 55 | 0 |
| Port des Francois | 58 | 36 | 0 | 137 | 45 | 0 |
| Behring's Bay | 59 | 7 | 20 | 138 | 24 | 0 |
| Admiralty Bay, | | | | | | |
| — Cape Phipps | 59 | 33 | 0 | 139 | 54 | 0 |
| Point Riou | 59 | 54 | 0 | 141 | 30 | 0 |
| Mount St. Elias | 60 | 22 | 30 | 141 | 0 | 0 |
| Cape Suckling | 60 | 1 | 0 | 143 | 42 | 0 |
| Cape Hammond | 59 | 48 | 30 | 144 | 26 | 0 |
| Pr. William's Sound, | | | | | | |
| — Cape Hinchinbroke | 60 | 16 | 30 | 146 | 26 | 0 |
| — Port Chalmers | 60 | 16 | 0 | 147 | 5 | 0 |
| *Var.* 28° 30′ *E.* | | | | | | |
| — Cape Puget | 59 | 54 | 30 | 148 | 15 | 0 |
| Middleton's or Rose I. | 59 | 32 | 0 | 146 | 22 | 0 |
| Chiswell's Islands, | | | | | | |
| — South Point | 59 | 31 | 0 | 149 | 24 | 0 |

*Vancouver's Island.*

*Queen Charlotte's Island.*



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## LATITUDES AND LONGITUDES.

| (99) Places. | Lat. N. | | | Lon. W. | | | (100) Places. | Lat. N. | | | Lon. E. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ | | ° | ′ | ″ | ° | ′ | ″ |
| Cape Elizabeth | 59 | 9 | 0 | 151 | 27 | 0 | Mednoi or Copper I., | | | | | | |
| Port Chatham | 59 | 14 | 0 | 151 | 14 | 0 | — South Point | 54 | 32 | 40 | 168 | 10 | 51 |
| *Var.* 21° 0′ *E.* | | | | | | | | | | | West | | |
| Anchor Point | 59 | 39 | 0 | 151 | 39 | 0 | St. George's Islands | 56 | 36 | 0 | 169 | 0 | 0 |
| East Foreland | 60 | 43 | 0 | 150 | 58 | 0 | Sea Otter's Island | 57 | 2 | 15 | 170 | 10 | 30 |
| West Foreland | 60 | 42 | 0 | 151 | 16 | 0 | St. Paul's Island | 57 | 6 | 0 | 170 | 0 | 0 |
| Point Campbell | 61 | 8 | 0 | 149 | 38 | 0 | Numwack I., N.E. Pt. | 60 | 32 | 0 | 165 | 26 | 0 |
| Point Harriott | 60 | 24 | 0 | 151 | 48 | 0 | — South East Point | 60 | 0 | 0 | 165 | 7 | 0 |
| Cape Douglas | 58 | 52 | 0 | 152 | 50 | 0 | Matwi or Gore's I., | | | | | | |
| | | | | | | | — Cape Upright | 60 | 17 | 0 | 172 | 30 | 0 |
| Point Banks | 58 | 40 | 0 | 152 | 6 | 0 | St. Lawrence Islands, | | | | | | |
| I. St. Hermogenes | 58 | 10 | 30 | 151 | 30 | 0 | — S. W. end | 63 | 30 | 0 | 171 | 36 | 0 |
| Cape Grenville | 57 | 34 | 30 | 152 | 0 | 0 | — N. W. Point | 63 | 46 | 0 | 171 | 41 | 0 |
| Port St. Paul | 57 | 46 | 50 | 152 | 18 | 0 | — East Point | 63 | 18 | 0 | 168 | 48 | 0 |
| Cape Barnabas | 57 | 10 | 0 | 152 | 39 | 0 | King's Island | 64 | 52 | 0 | 168 | 0 | 0 |
| Cape Trinity | 56 | 45 | 0 | 153 | 38 | 0 | Bhering's or | | | | | | |
| | | | | | | | Gwozdiff's Islands | 65 | 50 | 0 | 169 | 0 | 0 |
| Trinity Islands | 56 | 33 | 30 | 153 | 36 | 0 | Alesaska, S.W. Point | 54 | 41 | 0 | 163 | 26 | 0 |
| Tschirikoff I., N. Pt | 55 | 54 | 0 | 155 | 8 | 0 | Bristol Bay, | | | | | | |
| Schoomagen Islands, | | | | | | | — Ougaguck R. entr. | 57 | 52 | 0 | 157 | 24 | 0 |
| — South Island | 54 | 45 | 0 | 160 | 0 | 0 | — Cape Etolin | 58 | 38 | 0 | 158 | 20 | 0 |
| Halibut Islands, | | | | | | | — Cape Constantine | 58 | 28 | 0 | 158 | 45 | 0 |
| — Sannagh Island | 54 | 27 | 0 | 163 | 0 | 0 | — Hagemersta Island, | | | | | | |
| Isanotzky Str., S.entr. | 54 | 34 | 0 | 163 | 28 | 0 | Cape Calm | 58 | 33 | 30 | 161 | 11 | 0 |
| | | | | | | | — Cape Newham | 58 | 41 | 30 | 162 | 19 | 30 |
| Ounimack I., N.W. Pt | 54 | 45 | 0 | 165 | 10 | 0 | Shoal Ness | 60 | 0 | 0 | 162 | 0 | 0 |
| — N. E. Point | 54 | 50 | 0 | 163 | 35 | 0 | Shallow Water Point | 63 | 6 | 0 | 162 | 40 | 0 |
| Oonalashka I., S.W. Pt. | 53 | 13 | 0 | 167 | 47 | 0 | Cape Stephens | 63 | 33 | 30 | 162 | 17 | 0 |
| — Port Illuluk | 53 | 52 | 25 | 166 | 32 | 0 | Cape Denbigh | 64 | 23 | 0 | 161 | 40 | 0 |
| *Var.* 19° 24′ *E.* | | | | | | | Cape Rodney | 64 | 39 | 0 | 166 | 20 | 0 |
| Oumanack I., S.W. Pt. | 52 | 51 | 0 | 168 | 50 | 0 | Cape Prince of Wales | 65 | 35 | 30 | 168 | 0 | 0 |
| — N. E. Point | 53 | 30 | 0 | 167 | 16 | 0 | Cape Lowenstern | 66 | 16 | 0 | 165 | 35 | 0 |
| Kounaska Island, mid | 52 | 40 | 0 | 170 | 15 | 0 | Kotzebue's Sound, | | | | | | |
| Tschegoula Island | 52 | 40 | 0 | 170 | 34 | 0 | — Cape Krusenstern | 67 | 4 | 0 | 163 | 37 | 0 |
| Amoughta Island | 52 | 33 | 0 | 170 | 45 | 0 | *Var.* 25° 40′ *E.* | | | | | | |
| Seguam Island, mid | 52 | 22 | 0 | 172 | 18 | 0 | — Chamiso Island | 66 | 13 | 11 | 161 | 46 | 0 |
| Atcha Island, N.E. Pt. | 52 | 32 | 0 | 173 | 40 | 0 | *Var.* 31° 10′ *E.* | | | | | | |
| — West Point | 52 | 5 | 0 | 175 | 20 | 0 | Point Hope | 68 | 20 | 0 | 166 | 45 | 0 |
| Sitchin Island | 52 | 11 | 0 | 176 | 5 | 0 | Cape Lisburne | 68 | 52 | 0 | 166 | 10 | 0 |
| Adach Island, N.E. Pt. | 52 | 5 | 0 | 176 | 22 | 0 | Icy Cape | 70 | 17 | 30 | 161 | 40 | 0 |
| Kanaga Island, N. Pt. | 52 | 4 | 0 | 176 | 50 | 0 | Point Barrow | 71 | 25 | 0 | 156 | 10 | 0 |
| Tanaga Island, Bay | 51 | 52 | 0 | 178 | 2 | 0 | *Var.* 42° 15′ *E.* | | | | | | |
| — North Point | 52 | 3 | 0 | 178 | 0 | 0 | | | | | | | |
| Brulee Island | 51 | 56 | 0 | 178 | 40 | 0 | Point Beechey | 70 | 24 | 0 | 149 | 35 | 0 |
| Amatignac Island | 51 | 5 | 0 | 178 | 55 | 0 | Return Reef | 70 | 25 | 53 | 148 | 52 | 0 |
| | | | | | East | | *Var.* 41° 20′ *E.* | | | | | | |
| Amtschitka I., W. Pt. | 51 | 43 | 0 | 178 | 45 | 0 | Lion and Reliance Reef | 70 | 12 | 30 | 146 | 51 | 0 |
| — East Point | 51 | 34 | 0 | 179 | 40 | 0 | Flaxman's I., N. side | 70 | 11 | 22 | 145 | 49 | 57 |
| Rat Island | 51 | 48 | 0 | 178 | 24 | 0 | Barter Island, W. end | 70 | 5 | 11 | 143 | 54 | 55 |
| Tschegoula Islands | 52 | 14 | 0 | 178 | 22 | 0 | Point Manning | 70 | 6 | 30 | 143 | 35 | 0 |
| Kiska Island, N. Pt. | 52 | 22 | 0 | 177 | 50 | 0 | Point Griffin | 70 | 1 | 0 | 142 | 43 | 0 |
| Boulayr Island | 52 | 42 | 0 | 176 | 13 | 0 | Icy Reef | 69 | 43 | 30 | 141 | 29 | 45 |
| Semitsch Islands | 53 | 6 | 0 | 174 | 0 | 0 | Demarcation Point | 69 | 41 | 0 | 141 | 7 | 0 |
| Agattou Island | 52 | 43 | 0 | 173 | 38 | 0 | Herschel Island, S. Pt. | 69 | 33 | 38 | 139 | 3 | 10 |
| Attou I., E Point | 52 | 58 | 0 | 173 | 30 | 0 | Babbage R., Pt. Kay | 69 | 18 | 45 | 138 | 10 | 30 |
| — West Point | 52 | 58 | 0 | 172 | 17 | 0 | *Var.* 46° 16′ *E.* | | | | | | |
| — Massacre Bay | 52 | 50 | 0 | 173 | 12 | 0 | Point Sabine | 69 | 4 | 0 | 137 | 33 | 0 |
| | | | | | | | Pelly Islands | 69 | 34 | 0 | 135 | 32 | 0 |
| Bhering's Island, S Pt. | 54 | 21 | 0 | 166 | 44 | 0 | Garry I., N.W. end | 69 | 28 | 52 | 135 | 40 | 55 |
| — North Point | 55 | 22 | 0 | 165 | 56 | 0 | Kendall's Island, mid. | 69 | 23 | 0 | 135 | 16 | 0 |
| Mednoi or Copper I., | | | | | | | Ellice I., S.W. side | 69 | 5 | 0 | 135 | 47 | 0 |
| — North Point | 54 | 52 | 30 | 167 | 32 | 30 | Refuge Cove | 69 | 28 | 59 | 132 | 33 | 0 |

Cook's Inlet. Kodiak. Aleutian Archipelago. Sea of Kamtschatka. Russian America. Russian America.

# TABLE LVI.

## LATITUDES AND LONGITUDES.

| (101) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Toker Point | 69 | 37 | 50 | 132 | 15 | 0 |
| *Var.* 50° 43′ *E.* | | | | | | |
| Point Warren | 69 | 47 | 0 | 131 | 35 | 0 |
| Cape Dalhousie | 70 | 16 | 0 | 129 | 18 | 0 |
| Cape Bathurst | 70 | 36 | 0 | 127 | 35 | 0 |
| Cape Parry | 70 | 6 | 0 | 123 | 35 | 0 |
| *Var.* 55° 47′ *E.* | | | | | | |
| Burrow Island | 69 | 49 | 7 | 123 | 33 | 32 |
| Cape Lyon | 69 | 46 | 25 | 122 | 50 | 55 |
| Point Deas Thompson | 69 | 45 | 0 | 121 | 20 | 0 |
| *Var.* 53° 0′ *E.* | | | | | | |
| Point Tinney | 69 | 20 | 1 | 119 | 42 | 0 |
| Point Clifton | 69 | 13 | 15 | 118 | 27 | 0 |
| Cape Sir W. Hope | 68 | 58 | 23 | 116 | 26 | 0 |
| Point Cockburn | 68 | 52 | 0 | 115 | 0 | 0 |
| Cape Krusenstern | 68 | 22 | 0 | 113 | 46 | 0 |
| Bazil Hall's Bay, | | | | | | |
| — Cape Hearne | 68 | 12 | 0 | 114 | 52 | 0 |
| Cape Kendall | 67 | 58 | 26 | 115 | 18 | 0 |
| Point Turnagain | 68 | 18 | 50 | 109 | 25 | 0 |

## XXIV. The EAST COAST of AMERICA from CAPE HORN to CAPE SABLE.

| | South | | | West | | |
|---|---|---|---|---|---|---|
| Cape Horn | 55 | 58 | 30 | 67 | 21 | 15 |
| *Var.* 22° 30′ *E.* | | | | | | |
| Barnevelt's Islands | 55 | 49 | 0 | 66 | 49 | 30 |
| Evout's Islands | 55 | 32 | 15 | 66 | 47 | 30 |
| Le Maire's Strait, | | | | | | |
| — Cape Success | 55 | 1 | 30 | 65 | 17 | 30 |
| — Bay of Success | 54 | 49 | 45 | 65 | 15 | 0 |
| Staten Island, | | | | | | |
| — Cape St. John | 54 | 47 | 10 | 63 | 42 | 30 |
| — New Year's Harb. | 54 | 48 | 55 | 63 | 59 | 30 |
| Cape St. Ines | 54 | 8 | 0 | 66 | 57 | 45 |
| Cape St. Sebastian | 53 | 27 | 0 | 67 | 59 | 0 |
| Strait of Magellan, | | | | | | |
| — Queen Catharine's Foreland | 52 | 41 | 0 | 68 | 25 | 30 |
| — Cape Virginis | 52 | 21 | 0 | 68 | 17 | 40 |
| — Cape Froward | 53 | 53 | 20 | 71 | 11 | 0 |
| River Gallegos, | | | | | | |
| — Graciosa Dios Pt. | 51 | 43 | 0 | 69 | 7 | 0 |
| — Cape Fairweather | 51 | 33 | 0 | 69 | 0 | 0 |
| Sta. Cruz Harbour | 50 | 17 | 30 | 68 | 31 | 30 |
| Port St. Julian | 49 | 8 | 0 | 67 | 43 | 30 |
| Port Desire | 47 | 45 | 0 | 66 | 3 | 30 |
| Cape Blanco | 47 | 16 | 0 | 65 | 39 | 30 |
| St. George's Bay, | | | | | | |
| — Port Cordova | 45 | 45 | 0 | 67 | 27 | 30 |
| — Port Malaspena | 45 | 11 | 15 | 66 | 40 | 0 |
| Port Melo | 45 | 3 | 0 | 66 | 2 | 0 |
| Port St. Antonio | 45 | 2 | 30 | 65 | 49 | 0 |
| Port St. Elena, obs. | 44 | 29 | 45 | 65 | 29 | 45 |
| Port Valdes | 42 | 30 | 0 | 63 | 40 | 30 |
| Rio Negro, entr. | 40 | 59 | 0 | 63 | 4 | 0 |
| Cape Corrientes | 38 | 0 | 0 | 57 | 40 | 0 |
| River Plate, | | | | | | |
| — Cape St. Antonio | 36 | 19 | 30 | 56 | 42 | 30 |
| — Point Piedras | 35 | 27 | 0 | 57 | 9 | 0 |

*Terra del Fuego.* *Patagonia.*

| (102) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| River Plate, | | | | | | |
| — Buenos Ayres | 34 | 36 | 0 | 58 | 24 | 45 |
| — Colonia | 34 | 28 | 0 | 57 | 53 | 0 |
| — Montevideo, Light | 34 | 53 | 30 | 56 | 16 | 0 |
| — Maldonado Bay, | | | | | | |
| East Point | 34 | 57 | 15 | 54 | 49 | 0 |
| — Gorriti I., N.W. Pt | 34 | 56 | 0 | 54 | 50 | 30 |
| — Flores Island, Light | 34 | 56 | 30 | 55 | 54 | 0 |
| — Lobos Island | 35 | 1 | 15 | 54 | 44 | 32 |
| Cape Sta. Maria | 34 | 40 | 0 | 54 | 1 | 30 |
| Rio Grande, | | | | | | |
| — Port St. Pedro | 32 | 9 | 0 | 52 | 3 | 0 |
| St. Catharine's I., | | | | | | |
| — South Point | 27 | 51 | 30 | 48 | 41 | 0 |
| — North East Point | 27 | 26 | 0 | 48 | 28 | 30 |
| — Point Rapa | 27 | 22 | 31 | 48 | 32 | 7 |
| — Desterro Church | 27 | 35 | 36 | 48 | 39 | 53 |
| Anhatomirin Island, | | | | | | |
| — Sta. Cruz Fort | 27 | 25 | 32 | 48 | 40 | 59 |
| *Var.* 7° 29′ *E.* | | | | | | |
| Arvoredo Island | 27 | 16 | 47 | 48 | 29 | 0 |
| Itapacoroya Point | 26 | 47 | 18 | 48 | 44 | 0 |
| Remedios Is., S. end | 26 | 29 | 28 | 48 | 41 | 44 |
| Tamboreti Is., S. end | 26 | 20 | 54 | 48 | 38 | 45 |
| St. Francisco River, | | | | | | |
| — Joaõ Dias Point | 26 | 6 | 33 | 48 | 39 | 41 |
| Guaratuba River, | | | | | | |
| — Caiuva Mount | 25 | 49 | 30 | 48 | 41 | 23 |
| Itacolomi Rocks | 25 | 50 | 20 | 48 | 32 | 39 |
| Coral Rock | 25 | 45 | 49 | 48 | 30 | 5 |
| Paranagua Bay, | | | | | | |
| — South Island | 25 | 34 | 8 | 48 | 26 | 50 |
| *Var.* 7° 39′ *E.* | | | | | | |
| Isle do Mel, S. end | 25 | 32 | 43 | 48 | 25 | 40 |
| Figo Rock | 25 | 22 | 5 | 48 | 9 | 35 |
| Castillo Rock | 25 | 15 | 44 | 48 | 3 | 4 |
| Bom Abrigo Island | 25 | 6 | 49 | 47 | 57 | 36 |
| Jurea Point | 24 | 32 | 40 | 47 | 18 | 55 |
| Little Queimada I. | 24 | 21 | 26 | 46 | 54 | 32 |
| Grand Queimada I. | 24 | 28 | 21 | 46 | 46 | 35 |
| Laage Island | 24 | 13 | 6 | 46 | 47 | 35 |
| Port of Santos, | | | | | | |
| — Point Taypu | 24 | 1 | 11 | 46 | 30 | 20 |
| *Var.* 6° 1′ *E.* | | | | | | |
| — Point Grossa | 23 | 59 | 24 | 46 | 24 | 39 |
| Moela Island | 24 | 1 | 56 | 46 | 21 | 52 |
| Lage de Santos | 24 | 18 | 3 | 46 | 17 | 31 |
| Mount Trigo | 23 | 51 | 4 | 45 | 51 | 47 |
| Alcatrade Island | 24 | 6 | 5 | 45 | 46 | 32 |
| Toquetoque Island | 23 | 50 | 19 | 45 | 35 | 34 |
| St. Sebastian's Island, | | | | | | |
| — Point Seputuba | 23 | 56 | 3 | 45 | 29 | 52 |
| — Point Pirasomungo | 23 | 57 | 32 | 45 | 20 | 18 |
| *Var.* 4° 44′ *E.* | | | | | | |
| — Villa Nueva | 23 | 46 | 52 | 45 | 26 | 42 |
| Point das Ostres | 23 | 34 | 52 | 45 | 17 | 9 |
| Porcos Island, S. end | 23 | 33 | 38 | 45 | 10 | 3 |
| Busios Is., S. E. end | 23 | 44 | 27 | 45 | 5 | 49 |
| Victoria Island | 23 | 47 | 42 | 45 | 13 | 35 |
| Point Grossa | 23 | 28 | 15 | 45 | 7 | 5 |
| Couves Islands | 23 | 25 | 54 | 44 | 57 | 39 |
| Joatinga Point | 23 | 18 | 30 | 44 | 38 | 47 |

*Buenos Ayres.* *East Coast of Brazil.*

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## LATITUDES AND LONGITUDES.

| (103) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Grande I., S.W. Pt. | 23 | 15 | 12 | 44 | 29 | 13 |
| George Greco Island, | | | | | | |
| — S.W. Point | 23 | 15 | 11 | 44 | 19 | 27 |
| Marambaya Hill | 23 | 5 | 9 | 44 | 8 | 19 |
| La Gabia or Gavia | 22 | 59 | 0 | 43 | 22 | 43 |
| Rio Janeiro or | | | | | | |
| St. Sebastian | 22 | 54 | 15 | 43 | 15 | 50 |
| *Var.* 3° 40′ *E.* | | | | | | |
| Ratos or Rat Island | 22 | 53 | 16 | 43 | 14 | 59 |
| Sugar Loaf | 22 | 56 | 8 | 43 | 14 | 28 |
| Gloria | 22 | 54 | 42 | 43 | 15 | 34 |
| Redondo or Round I. | 23 | 3 | 45 | 43 | 17 | 4 |
| Marica Islands | 23 | 0 | 53 | 42 | 59 | 53 |
| Cape Negro | 22 | 57 | 10 | 42 | 44 | 54 |
| Cape Frio | 23 | 1 | 18 | 42 | 3 | 19 |
| *Var.* 2° 30′ *E.* | | | | | | |
| Papagoyos Islands, | | | | | | |
| — N. E. end | 22 | 52 | 9 | 41 | 58 | 20 |
| Anchora Is., E. end | 22 | 46 | 26 | 41 | 50 | 57 |
| Cape Buzois | 22 | 46 | 3 | 41 | 55 | 53 |
| St. John's Hill | 22 | 32 | 26 | 42 | 6 | 19 |
| St. Ann's Is., largest | 22 | 25 | 0 | 41 | 46 | 22 |
| Cape St. Thomas, abt. | 22 | 3 | 0 | 41 | 0 | 0 |
| Point Maruba | 21 | 11 | 0 | 40 | 50 | 0 |
| Mount Benevente | 20 | 55 | 21 | 40 | 49 | 24 |
| Guarapari | 20 | 43 | 56 | 40 | 32 | 42 |
| Calvado Island | 20 | 44 | 8 | 40 | 27 | 8 |
| Rasas Island | 20 | 42 | 42 | 40 | 24 | 31 |
| Jicu Point | 20 | 26 | 1 | 40 | 22 | 1 |
| Jicu Island | 20 | 23 | 9 | 40 | 20 | 30 |
| Pacotes Rocks | 20 | 21 | 2 | 40 | 17 | 29 |
| *Var.* 0° 56′ *E.* | | | | | | |
| Espiritu Santos Bay, | | | | | | |
| — Mount Moreno | 20 | 19 | 23 | 40 | 19 | 25 |
| — Victoria, Town | 20 | 19 | 0 | 40 | 23 | 0 |
| — Point Tubarao | 20 | 16 | 22 | 40 | 17 | 29 |
| Rio Doce, entr. | 19 | 36 | 57 | 39 | 51 | 21 |
| *Var.* 0° 5′ *E.* | | | | | | |
| St. Matthew's R. entr. | 18 | 37 | 10 | 39 | 45 | 5 |
| Abrolhos Is., largest | 17 | 57 | 44 | 38 | 41 | 54 |
| *Var.* 0° 46′ *W.* | | | | | | |
| Parades Shoals, N.end | 17 | 56 | 45 | 38 | 54 | 20 |
| Prado, Town | 17 | 21 | 28 | 39 | 12 | 19 |
| Columbiana | 17 | 6 | 1 | 39 | 11 | 58 |
| Cramimuan R., entr. | 16 | 51 | 12 | 39 | 9 | 29 |
| Mount Pascal | 16 | 54 | 8 | 39 | 25 | 25 |
| Porto Seguro | 16 | 26 | 50 | 39 | 3 | 18 |
| *Var.* 0° 54′ *W.* | | | | | | |
| Santa Cruz | 16 | 18 | 50 | 39 | 1 | 49 |
| Belmonte | 15 | 51 | 4 | 38 | 54 | 13 |
| Commandatuba | 15 | 25 | 20 | 38 | 56 | 22 |
| Unha | 14 | 59 | 7 | 38 | 57 | 45 |
| St. George dos Ilheos | 14 | 49 | 25 | 39 | 0 | 10 |
| Os Ilheos | 14 | 47 | 23 | 38 | 58 | 58 |
| Contas | 14 | 18 | 6 | 39 | 0 | 2 |
| Mula Point | 13 | 53 | 5 | 38 | 56 | 37 |
| Queipé Island | 13 | 50 | 58 | 38 | 56 | 35 |
| Boypeda Island | 13 | 37 | 43 | 38 | 56 | 36 |
| St. Paul's Mount | 13 | 21 | 53 | 38 | 54 | 8 |
| Itaporica Island, | | | | | | |
| — South Point | 13 | 7 | 33 | 38 | 46 | 21 |
| — N. S. de Penha | 12 | 59 | 16 | 38 | 36 | 21 |

East Coast of Brazil.

| (104) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| — Jaburu | 12 | 57 | 36 | 38 | 35 | 41 |
| — Mount St. Amaro | 13 | 1 | 8 | 38 | 45 | 15 |
| Bay of Santos, | | | | | | |
| — Frades Island | 12 | 49 | 28 | 38 | 37 | 45 |
| St. Salvador or Bahia, | | | | | | |
| — Mount Serati | 12 | 55 | 58 | 38 | 30 | 49 |
| — St. Antonio | 13 | 0 | 11 | 38 | 31 | 34 |
| *Var.* 1° 58′ *W.* | | | | | | |
| Itapuanzinho Point | 13 | 0 | 59 | 38 | 27 | 55 |
| Itapuan | 12 | 57 | 3 | 38 | 21 | 28 |
| Jacuipe River, entr. | 12 | 41 | 52 | 38 | 7 | 28 |
| Garcia de Avila | 12 | 32 | 26 | 38 | 0 | 43 |
| Rio Real, S. Point | 11 | 28 | 4 | 37 | 20 | 13 |
| Os tres Irmaos or | | | | | | |
| Three Brothers | 11 | 15 | 37 | 37 | 9 | 58 |
| Vasa Barris River | 11 | 11 | 0 | 37 | 16 | 51 |
| St Francisco R., S. Pt. | 10 | 28 | 50 | 36 | 23 | 22 |
| *Var.* 3° 10′ *W.* | | | | | | |
| St. Antonio Mount | 9 | 22 | 17 | 35 | 35 | 5 |
| Porto Francez | 9 | 39 | 45 | 35 | 41 | 19 |
| Quinta | 9 | 16 | 18 | 35 | 22 | 25 |
| St. Bento | 9 | 4 | 56 | 35 | 16 | 57 |
| Tamandaré Fort | 8 | 43 | 24 | 35 | 5 | 0 |
| Fermoso River | 8 | 39 | 40 | 35 | 4 | 22 |
| Aleixo Islands | 8 | 35 | 49 | 35 | 0 | 46 |
| Maracay | 8 | 29 | 26 | 34 | 59 | 37 |
| Cape St. Augustine | 8 | 20 | 41 | 34 | 56 | 42 |
| *Var.* 4° 30′ *W.* | | | | | | |
| Rosario | 8 | 9 | 18 | 34 | 55 | 52 |
| Pernambuco, | | | | | | |
| — Recife, Tower | 8 | 4 | 7 | 34 | 52 | 44 |
| — Fort Picao | 8 | 3 | 27 | 34 | 51 | 50 |
| *Var.* 4° 45′ *W.* | | | | | | |
| Olinda | 8 | 0 | 59 | 34 | 50 | 48 |
| Sta. Maria Farinha | 7 | 56 | 43 | 34 | 50 | 36 |
| Rio Aye, entrance | 7 | 47 | 13 | 34 | 50 | 35 |
| River Goyana, entr. | 7 | 37 | 44 | 34 | 49 | 8 |
| Pilar, Village | 7 | 35 | 35 | 34 | 47 | 47 |
| R. Grande de Goyana | 7 | 30 | 40 | 34 | 48 | 22 |
| Cape Branco | 7 | 8 | 22 | 34 | 48 | 5 |
| North Paranahyba | 7 | 6 | 3 | 34 | 53 | 0 |
| Paranahyba River, | | | | | | |
| — Fort Cabedello | 6 | 57 | 50 | 34 | 50 | 11 |
| Point Lucena | 6 | 53 | 35 | 34 | 52 | 35 |
| Traico Bay, N. Point | 6 | 41 | 15 | 34 | 57 | 23 |
| Formosa Bay, S. Pt. | 6 | 23 | 12 | 35 | 0 | 12 |
| River Cunhao | 6 | 17 | 10 | 35 | 3 | 25 |
| Point Pipa | 6 | 12 | 53 | 35 | 3 | 42 |
| Point Negra | 5 | 52 | 52 | 35 | 12 | 5 |
| Rio Grande, Fort | 5 | 45 | 0 | 35 | 14 | 31 |
| Cape St. Roque | 5 | 28 | 17 | 35 | 17 | 10 |
| *Var.* 4° 55′ *W.* | | | | | | |
| Point Petetinga | 5 | 21 | 35 | 35 | 19 | 30 |
| Point Calcanhar | 5 | 8 | 20 | 35 | 30 | 40 |
| Lavandeira Breakers | 4 | 54 | 40 | 36 | 2 | 10 |
| Urcas Breakers | 4 | 51 | 32 | 36 | 18 | 35 |
| Point Tubarao | 5 | 1 | 49 | 36 | 28 | 10 |
| Point do Mel | 4 | 55 | 17 | 36 | 59 | 15 |
| Reteiro Pequino | 4 | 48 | 16 | 37 | 19 | 15 |
| Reteiro Grande | 4 | 36 | 20 | 37 | 32 | 55 |
| Aracati Mount | 4 | 42 | 10 | 37 | 54 | 50 |

North Coast of Brazil.

## LATITUDES AND LONGITUDES.

| | (105) Places. | Lat. S. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| North Coast of Brazil. | Point Macoripi | 3 | 41 | 50 | 38 | 30 | 51 |
| | *Var.* 3° 0′ *W.* | | | | | | |
| | Seara or Ciara | 3 | 42 | 58 | 38 | 33 | 58 |
| | Mount Melancia | 3 | 11 | 40 | 39 | 19 | 31 |
| | Perpambuquinho | 3 | 1 | 50 | 39 | 37 | 28 |
| | Patos River, entrance | 2 | 58 | 50 | 39 | 40 | 3 |
| | Jericacoara Point | 2 | 47 | 28 | 40 | 27 | 25 |
| | Camercim River, entr. | 2 | 50 | 0 | 40 | 45 | 5 |
| | Tapuya Mount | 2 | 58 | 25 | 40 | 50 | 39 |
| | Iguarassu River, entr. | 2 | 52 | 27 | 41 | 38 | 12 |
| | Tutoya River, entr. | 2 | 41 | 13 | 42 | 12 | 11 |
| | Perguicas R., E. Pt. | 2 | 41 | 27 | 42 | 27 | 11 |
| | LancoesGrandes,E.Pt | 2 | 26 | 12 | 43 | 0 | 1 |
| | Alegre Mount | 2 | 20 | 17 | 43 | 13 | 14 |
| | *Var.* 0° 0′ | | | | | | |
| | St. Ann's Breakers, | | | | | | |
| | — East Point | 2 | 12 | 38 | 43 | 29 | 39 |
| | St. Ann's I., N.E. Pt. | 2 | 14 | 44 | 43 | 38 | 26 |
| | CoreaGrandeBreakers | | | | | | |
| | — North Part | 2 | 10 | 55 | 43 | 57 | 41 |
| | Maranham Island, | | | | | | |
| | — White Down on | | | | | | |
| | North side | 2 | 24 | 36 | 44 | 4 | 18 |
| | — Fort St. Marcos | 2 | 28 | 22 | 44 | 16 | 3 |
| | — Fort St. Antonio | 2 | 29 | 24 | 44 | 16 | 56 |
| | *Var.* 1° 37′ *W.* | | | | | | |
| | — St. Luiz | 2 | 30 | 44 | 44 | 16 | 9 |
| | Alcantara | 2 | 23 | 33 | 44 | 23 | 7 |
| | Mount Alegré | 2 | 17 | 16 | 44 | 20 | 5 |
| | Mount Itacolimi | 2 | 8 | 38 | 44 | 24 | 33 |
| | Shoal of Manoel Luiz | | | | | | |
| | — West Rock | 0 | 51 | 25 | 44 | 14 | 45 |
| | *Var.* 0° 57′ *E.* | | | | | | |
| | Appleton's Shoal | 0 | 45 | 0 | 44 | 10 | 0 |
| | Sylva Shoal | 0 | 32 | 0 | 44 | 17 | 21 |
| | Para or Belim | 1 | 28 | 0 | 48 | 35 | 0 |
| | Cape Magoary | 0 | 17 | 0 | 48 | 33 | 0 |
| | | North | | | | | |
| | Cape North | 1 | 51 | 0 | 50 | 9 | 0 |
| Guayana. | Oyapok River, | | | | | | |
| | — St. Louis, Fort | 3 | 57 | 0 | 51 | 41 | 0 |
| | Cayenne, Flagstaff | 4 | 56 | 19 | 52 | 14 | 45 |
| | *Var.* 2° 28′ *E.* | | | | | | |
| | Surinam R., Brams Pt. | 5 | 56 | 0 | 55 | 15 | 0 |
| | — Paramaribo | 5 | 49 | 0 | 55 | 13 | 30 |
| | River Demerary, | | | | | | |
| | — Corrobano Pt., Lt. | 6 | 48 | 0 | 58 | 1 | 35 |
| | — George Town | 6 | 47 | 0 | 58 | 1 | 0 |
| | Cape Nassau | 7 | 32 | 0 | 58 | 49 | 0 |
| | Guayma River, entr. | 8 | 25 | 0 | 59 | 52 | 0 |
| | Orinoco River, | | | | | | |
| | — Point Barima | 8 | 44 | 30 | 60 | 3 | 0 |
| | — Old Guayana | 8 | 8 | 24 | 62 | 23 | 0 |
| | — Angostura | 8 | 8 | 11 | 63 | 55 | 20 |
| | The Testigos, N.E.Pt. | 11 | 24 | 30 | 63 | 9 | 30 |
| | La Sola | 11 | 19 | 30 | 63 | 39 | 45 |
| | Los Frayles, N. Rks. | 11 | 15 | 30 | 63 | 50 | 0 |
| | Margarita, | | | | | | |
| | — Mosquitos or | | | | | | |
| | S. E. Point | 10 | 53 | 0 | 63 | 59 | 0 |

| | (106) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| The Leeward Islands. | Margarita, | | | | | | |
| | — Pampatar | 10 | 59 | 15 | 63 | 53 | 30 |
| | — Balena Point | 10 | 59 | 0 | 63 | 51 | 45 |
| | — North Point | 11 | 10 | 30 | 63 | 58 | 30 |
| | — Galera Point | 11 | 6 | 30 | 64 | 4 | 30 |
| | — Tuna Point | 11 | 5 | 30 | 64 | 18 | 0 |
| | — Sandy Point | 10 | 59 | 0 | 64 | 29 | 30 |
| | — Mangles Point | 10 | 52 | 0 | 64 | 9 | 0 |
| | Blanquilla, | | | | | | |
| | — North Point | 11 | 54 | 30 | 64 | 41 | 50 |
| | — S. E. Point | 11 | 48 | 30 | 64 | 40 | 15 |
| | Tortuga, | | | | | | |
| | — S. E. Point | 10 | 55 | 0 | 65 | 16 | 50 |
| | — West Point | 10 | 56 | 30 | 65 | 29 | 30 |
| | Orchilla, East end | 11 | 49 | 0 | 66 | 9 | 30 |
| | — West end | 11 | 49 | 0 | 66 | 15 | 40 |
| | Two Fathoms Shoal | 12 | 9 | 15 | 66 | 9 | 20 |
| | Los Roques, S.E. Pt. | 11 | 47 | 0 | 66 | 39 | 0 |
| | — Salt Kay, W. Pt. | 11 | 46 | 0 | 66 | 54 | 0 |
| | — N. E. Kay | 11 | 58 | 40 | 66 | 42 | 20 |
| | — West Kay | 11 | 50 | 0 | 67 | 1 | 0 |
| | Aves or Bird's Islands, | | | | | | |
| | — East end | 11 | 57 | 30 | 67 | 30 | 30 |
| | — West End | 11 | 59 | 30 | 67 | 45 | 30 |
| | Buenayre, N. Point | 12 | 19 | 15 | 68 | 30 | 0 |
| | — Rasa or S. Point | 12 | 2 | 30 | 68 | 21 | 30 |
| | Curacao, N. Point | 12 | 24 | 0 | 69 | 16 | 20 |
| | — Fort Amsterdam | 12 | 16 | 15 | 69 | 3 | 0 |
| | Little Curacao, N. end | 12 | 0 | 0 | 68 | 44 | 30 |
| | Oruba, S. E. Point | 12 | 23 | 45 | 69 | 59 | 30 |
| Coast of Colombia. | Cape Three Points | 10 | 45 | 15 | 62 | 46 | 0 |
| | Cape Malapasqua | 10 | 42 | 50 | 63 | 6 | 35 |
| | Cumana | 10 | 27 | 37 | 64 | 15 | 15 |
| | Porto Mochima, entr. | 10 | 24 | 0 | 64 | 26 | 30 |
| | Borracha I., N.E. Pt. | 10 | 19 | 30 | 64 | 49 | 20 |
| | Barcelona, Castle | 10 | 13 | 15 | 64 | 48 | 20 |
| | Piritu Isles, mid. | 10 | 9 | 0 | 65 | 1 | 35 |
| | Unare Island, middle. | 10 | 5 | 30 | 65 | 21 | 15 |
| | Cape Codera | 10 | 35 | 54 | 66 | 11 | 30 |
| | Point Chuspa | 10 | 39 | 30 | 66 | 25 | 30 |
| | La Guayra, Road | 10 | 37 | 0 | 67 | 1 | 35 |
| | Caracas | 10 | 30 | 0 | 67 | 0 | 55 |
| | Port Turiamo | 10 | 29 | 10 | 67 | 57 | 20 |
| | Porto Cabello, entr. | 10 | 29 | 45 | 68 | 7 | 35 |
| | Tucocas Point | 10 | 50 | 0 | 68 | 20 | 5 |
| | St. Juan's Point | 11 | 9 | 0 | 68 | 31 | 35 |
| | Ubero Point | 11 | 19 | 30 | 68 | 49 | 15 |
| | Manzanille Point | 11 | 31 | 15 | 69 | 24 | 5 |
| | Vela de Coro | 11 | 26 | 30 | 69 | 42 | 5 |
| | Cape St. Roman | 12 | 11 | 0 | 70 | 8 | 35 |
| | Sta. Anna de Coro | 11 | 24 | 0 | 69 | 49 | 50 |
| | Zapara Fort | 10 | 58 | 30 | 72 | 31 | 30 |
| | Maracaybo | 10 | 39 | 0 | 71 | 45 | 0 |
| | Point Espada | 12 | 4 | 0 | 71 | 11 | 50 |
| | Bahia Honda, entr. | 12 | 20 | 0 | 71 | 50 | 35 |
| | Cape La Vela | 12 | 11 | 0 | 72 | 15 | 35 |
| | La Hacha | 11 | 33 | 30 | 72 | 58 | 55 |
| | Cape St. Augustin | 11 | 16 | 0 | 73 | 40 | 5 |
| | C. St. Juan de Guia | 11 | 20 | 45 | 74 | 4 | 20 |
| | Cape de la Aguja | 18 | 18 | 30 | 74 | 16 | 20 |
| | Santa Marta | 11 | 15 | 0 | 74 | 17 | 35 |

## LATITUDES AND LONGITUDES.

| (107) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Coast of Colombia.* | | | | | | |
| Magdalena River, | | | | | | |
| — Rio Viego, entr. | 11 | 5 | 0 | 74 | 47 | 35 |
| — Ceneza entr. | 11 | 5 | 20 | 74 | 56 | 20 |
| Savanilla Point | 11 | 2 | 0 | 75 | 3 | 0 |
| Morro Hermoso | 10 | 58 | 0 | 75 | 4 | 45 |
| Cascabel Rock | 10 | 55 | 10 | 76 | 7 | 45 |
| Galera Point | 10 | 47 | 0 | 75 | 29 | 5 |
| Canoas Point | 10 | 34 | 15 | 75 | 35 | 50 |
| CARTAGENA, Popo. | 10 | 26 | 0 | 75 | 37 | 5 |
| Salmedina Shoal | 10 | 23 | 0 | 75 | 44 | 35 |
| Rosario Isles, largest | 10 | 11 | 0 | 75 | 49 | 35 |
| St. Bernardo Islands, | | | | | | |
| — Tintipan Island | 9 | 48 | 0 | 75 | 55 | 30 |
| Santiago di Tolu | 9 | 30 | 45 | 75 | 39 | 50 |
| Port Aspata, entrance | 9 | 25 | 0 | 75 | 51 | 55 |
| Fueste Island | 9 | 23 | 30 | 76 | 15 | 5 |
| Gulf of Darien, | | | | | | |
| — Point Arenas | 8 | 33 | 0 | 77 | 0 | 5 |
| — Cape Tiburon | 8 | 41 | 15 | 77 | 26 | 35 |
| Carreto | 8 | 47 | 15 | 77 | 38 | 35 |
| Pinos Island, N. Pt. | 9 | 1 | 30 | 77 | 50 | 30 |
| Cayo Ratones | 9 | 23 | 0 | 78 | 20 | 5 |
| Point St. Blas | 9 | 31 | 36 | 79 | 2 | 5 |
| Point Manzanillo | 9 | 39 | 30 | 79 | 36 | 50 |
| PUERTO VELO or PORTO BELLO | 9 | 34 | 29 | 79 | 43 | 40 |
| Point Toro | 9 | 23 | 45 | 80 | 1 | 20 |
| Chagres | 9 | 21 | 0 | 80 | 4 | 5 |
| *Bay of Honduras.* | | | | | | |
| Port Cartago | 10 | 4 | 0 | 82 | 35 | 0 |
| Port St. Juan de Nicaragua, | | | | | | |
| — Point Arenas | 11 | 0 | 0 | 82 | 44 | 0 |
| Bluefields or New Segovia | 11 | 49 | 0 | 83 | 2 | 0 |
| Roncador | 13 | 35 | 7 | 80 | 3 | 3 |
| Serranna, N. side | 14 | 28 | 36 | 80 | 15 | 0 |
| — South side | 14 | 18 | 17 | 80 | 15 | 0 |
| Serranilla, E. side | 15 | 45 | 20 | 79 | 51 | 15 |
| CAPE GRACIOS A DIOS | 14 | 55 | 0 | 82 | 45 | 0 |
| Cape Camaron | 16 | 2 | 0 | 85 | 14 | 0 |
| Cape Honduras | 16 | 0 | 0 | 86 | 5 | 0 |
| Truxillo | 15 | 54 | 0 | 86 | 2 | 0 |
| Swan Islands, S.E. Pt. | 17 | 22 | 30 | 83 | 51 | 0 |
| Albion Sh., E.N.E. end | 18 | 55 | 0 | 83 | 9 | 0 |
| Guanaja or Bonacca, | | | | | | |
| — North East Point | 16 | 31 | 20 | 85 | 55 | 30 |
| Barburat Island | 16 | 27 | 0 | 86 | 10 | 0 |
| Ruatan or Rattan, | | | | | | |
| — West Point, about | 16 | 16 | 0 | 86 | 51 | 0 |
| Cape Three Points | 15 | 58 | 0 | 88 | 34 | 0 |
| Teemarsh River | 15 | 59 | 0 | 88 | 56 | 0 |
| Moho River | 16 | 3 | 30 | 88 | 49 | 0 |
| Point Icacos | 16 | 15 | 0 | 88 | 36 | 0 |
| Point Placentia | 16 | 28 | 0 | 88 | 24 | 0 |
| Sittee River | 16 | 48 | 0 | 88 | 19 | 0 |
| Manati River | 17 | 14 | 0 | 88 | 19 | 0 |
| Seboon River | 17 | 25 | 0 | 88 | 15 | 0 |
| BELIZE, Fort George | 17 | 29 | 29 | 88 | 11 | 15 |
| Glover's Reef, N. end | 16 | 54 | 0 | 87 | 40 | 0 |
| — South End, about | 16 | 41 | 0 | 87 | 49 | 0 |
| Half Moon Kay, Light | 17 | 12 | 45 | 87 | 33 | 0 |

| (108) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Mexico.* | | | | | | |
| Hat Kay Reef, S. end | 17 | 6 | 0 | 87 | 40 | 0 |
| Turneff Kays, | | | | | | |
| — Kay Bokel | 17 | 9 | 40 | 87 | 56 | 0 |
| — Maugre Kay | 17 | 37 | 30 | 87 | 41 | 0 |
| English Kay | 17 | 19 | 30 | 88 | 2 | 30 |
| St. George's Kay, S. Pt. | 17 | 33 | 0 | 88 | 2 | 0 |
| Ambergris Kay, S. Pt. | 17 | 49 | 0 | 88 | 1 | 0 |
| Northern Triangles, | | | | | | |
| — South end | 18 | 20 | 0 | 87 | 20 | 0 |
| — North end | 18 | 45 | 0 | 87 | 15 | 0 |
| Cozumel, S. Point | 20 | 16 | 45 | 86 | 55 | 0 |
| — North Point | 20 | 39 | 0 | 86 | 44 | 0 |
| Arrowsmith's Bk mid. | 21 | 3 | 0 | 86 | 21 | 0 |
| Punta Brava | 21 | 0 | 0 | 86 | 44 | 0 |
| Cape Catoche | 21 | 34 | 0 | 86 | 57 | 30 |
| Mount Notiperderas | 21 | 10 | 0 | 90 | 2 | 30 |
| Campeche, Town | 19 | 51 | 0 | 90 | 30 | 0 |
| Alacran Shoal, | | | | | | |
| — Perez Island | 22 | 22 | 0 | 89 | 41 | 0 |
| Negrillo Bank | 23 | 25 | 0 | 90 | 12 | 37 |
| Arenas or Sandy I. | 22 | 8 | 0 | 91 | 20 | 0 |
| New Shoal | 21 | 50 | 0 | 91 | 55 | 0 |
| Triangle | 20 | 53 | 0 | 92 | 10 | 0 |
| Obiso or Bishop's Sh. | 20 | 30 | 0 | 92 | 12 | 0 |
| The Arcas | 20 | 12 | 0 | 91 | 56 | 0 |
| Javinal Point | 19 | 12 | 30 | 90 | 56 | 30 |
| Jicalango Point | 18 | 41 | 30 | 91 | 54 | 0 |
| Barra de St. Pedro | 18 | 40 | 0 | 92 | 29 | 30 |
| Barra de Tabasco | 18 | 34 | 16 | 92 | 39 | 13 |
| B. de Chiltepeque | 18 | 26 | 30 | 93 | 3 | 0 |
| Tupilco River, entr. | 18 | 25 | 0 | 93 | 25 | 0 |
| B. de Coazacoalcos | 18 | 8 | 0 | 94 | 22 | 0 |
| La Barilla | 18 | 9 | 0 | 94 | 35 | 0 |
| Point St. Juan | 18 | 18 | 0 | 94 | 38 | 0 |
| Roca Partida | 18 | 43 | 0 | 95 | 6 | 0 |
| Barra de Alvarado | 18 | 46 | 0 | 95 | 43 | 0 |
| Anton Lizardo Point | 19 | 3 | 0 | 95 | 55 | 0 |
| VERA CRUZ, Light | 19 | 12 | 15 | 96 | 7 | 12 |
| Orizava Peak | 19 | 2 | 17 | 97 | 12 | 15 |
| Cofre di Perote | 19 | 32 | 54 | 97 | 8 | 0 |
| MEXICO | 19 | 25 | 45 | 99 | 5 | 30 |
| Cape Roxo | 21 | 35 | 0 | 97 | 23 | 0 |
| Barra de Tampico | 22 | 15 | 56 | 97 | 52 | 0 |
| Barra de Tordo | 22 | 52 | 0 | 97 | 54 | 0 |
| Barra de Santander | 23 | 46 | 0 | 97 | 58 | 0 |
| Boquillas Cerradas | 25 | 0 | 0 | 97 | 40 | 0 |
| River de S. Fernando | 25 | 20 | 0 | 97 | 29 | 0 |
| Barra de Santiago | 26 | 6 | 0 | 97 | 10 | 0 |
| Barra de S. Bernardo | 28 | 55 | 0 | 95 | 48 | 0 |
| Point Culebras | 29 | 15 | 0 | 94 | 48 | 0 |
| Barra del R. Sabina | 29 | 36 | 0 | 94 | 2 | 0 |
| R. Mermentan, entr. | 29 | 30 | 0 | 92 | 55 | 0 |
| Fierro Point | 29 | 12 | 0 | 91 | 28 | 0 |
| Mississippi River, | | | | | | |
| — S.W. entrance | 28 | 58 | 0 | 89 | 29 | 0 |
| — South entrance | 28 | 58 | 0 | 89 | 11 | 0 |
| — Frank's I., Light | 29 | 8 | 30 | 89 | 6 | 0 |
| — Balize | 29 | 7 | 30 | 89 | 10 | 0 |
| — Pass à l'Outre | 29 | 13 | 0 | 89 | 8 | 0 |
| *United States.* | | | | | | |
| NEW ORLEANS | 29 | 57 | 30 | 90 | 6 | 17 |
| Mobile, Bar | 30 | 10 | 0 | 88 | 10 | 0 |
| *Var.* 6° 58′ *E.* | | | | | | |

## LATITUDES AND LONGITUDES.

| (109) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Mobile, Town | 30 | 39 | 0 | 88 | 12 | 0 |
| Pensacola, Bar | 30 | 18 | 0 | 87 | 16 | 0 |
| Pensacola, Town | 30 | 23 | 43 | 87 | 11 | 18 |
| Sta. Rosa Bay, entr. | 30 | 23 | 0 | 86 | 36 | 0 |
| St. Andrew's Island | 30 | 1 | 0 | 85 | 51 | 0 |
| Cape St. Blas | 29 | 38 | 0 | 85 | 40 | 0 |
| Apalaché or St. Mark | 30 | 12 | 0 | 84 | 30 | 0 |
| Anclote Kay, mid. | 28 | 20 | 0 | 83 | 12 | 0 |
| Spiritu Santo Bay, ent. | 27 | 42 | 0 | 82 | 52 | 0 |
| Boca de Sarasota | 27 | 17 | 0 | 82 | 39 | 0 |
| Carlos Bay, entr. | 26 | 37 | 0 | 82 | 12 | 0 |
| Punta Larga, or | | | | | | |
| Cape Roman | 25 | 50 | 0 | 81 | 46 | 0 |
| Cape Sable | 25 | 1 | 0 | 81 | 10 | 0 |

## XXV. THE WEST INDIA ISLANDS.

| | | | | | | |
|---|---|---|---|---|---|---|
| Bermudas or Somer's Islands, | | | | | | |
| — St. George Town | 32 | 22 | 0 | 64 | 43 | 0 |
| — St. David's Head | 32 | 21 | 0 | 64 | 41 | 0 |
| — S. extreme of land | 32 | 12 | 0 | 64 | 53 | 0 |
| — Wreck Hill or W. end | 32 | 16 | 0 | 64 | 57 | 0 |
| *Var.* 2° 50′ *W.* | | | | | | |
| — North Rock | 32 | 29 | 26 | 64 | 49 | 30 |
| — Mills' Breaker | 32 | 24 | 0 | 64 | 40 | 0 |
| Maternillo Bank, | | | | | | |
| — North end | 27 | 51 | 0 | 79 | 10 | 0 |
| Maternillo Reef, | | | | | | |
| — N.W. end | 27 | 34 | 0 | 79 | 9 | 0 |
| Outer part of | | | | | | |
| Western Reef | 27 | 5 | 0 | 79 | 12 | 0 |
| Memory Rock | 26 | 55 | 0 | 79 | 2 | 0 |
| Great Bahama, | | | | | | |
| — West end | 26 | 41 | 0 | 79 | 1 | 0 |
| — S. E. end | 26 | 28 | 0 | 78 | 40 | 0 |
| Hole in the Rock | 25 | 50 | 0 | 77 | 7 | 0 |
| *Var.* 4° 50′ *E.* | | | | | | |
| Abaco I., N. E. Pt. | 26 | 19 | 0 | 76 | 55 | 0 |
| Elbow Reef | 26 | 33 | 0 | 76 | 51 | 0 |
| Eleuthera, S. E. Point | 24 | 38 | 0 | 76 | 4 | 0 |
| — Governor's Hr. | 25 | 12 | 0 | 76 | 12 | 0 |
| — James' Cistern | 25 | 20 | 0 | 76 | 16 | 0 |
| — Harbour I., E. end | 25 | 30 | 0 | 76 | 34 | 0 |
| — Egg Island, Reef | 25 | 33 | 45 | 76 | 55 | 30 |
| Douglas' Passage, ent. | 25 | 8 | 30 | 77 | 2 | 45 |
| New Providence, | | | | | | |
| — Nassau, Light | 25 | 5 | 0 | 77 | 18 | 15 |
| *Var.* 5° 30′ *E.* | | | | | | |
| Berry Islands, | | | | | | |
| — Upper Club Point | 25 | 23 | 0 | 77 | 47 | 0 |
| — Great Stirrup Kay, N. E. end | 25 | 46 | 30 | 77 | 51 | 0 |
| Little Isaac | 25 | 59 | 0 | 78 | 52 | 0 |
| Great Isaac, mid. | 26 | 2 | 0 | 79 | 3 | 0 |
| Moselle Shoal | 25 | 50 | 0 | 79 | 15 | 0 |
| Bemini Islands, | | | | | | |
| — Barnett's Harbour | 25 | 36 | 0 | 79 | 17 | 0 |
| Riding Rocks | 25 | 11 | 0 | 79 | 8 | 0 |

*Little Bahama Bank.*

*Great Bahama Bank.*

| (110) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Orange Kays, mid. | 24 | 55 | 30 | 79 | 7 | 0 |
| Roquillas | 24 | 52 | 0 | 79 | 8 | 0 |
| Salt Kay Bank, | | | | | | |
| — Anguilla Kay, Well | 23 | 31 | 0 | 79 | 29 | 0 |
| — Salt Kay | 23 | 42 | 0 | 80 | 20 | 0 |
| — Elbow Kay | 23 | 55 | 0 | 80 | 25 | 30 |
| — Dog Rocks, mid. | 24 | 3 | 0 | 79 | 49 | 0 |
| Guincho or Ginger Kay | 22 | 47 | 0 | 77 | 57 | 0 |
| Lobos or Seal's Kay | 22 | 24 | 0 | 77 | 29 | 0 |
| Diamond Point | 22 | 9 | 0 | 77 | 12 | 0 |
| St. Domingo Kay | 21 | 45 | 0 | 75 | 45 | 0 |
| Kayo Verde, E. end | 22 | 0 | 0 | 75 | 13 | 30 |
| Jumentos, | | | | | | |
| — Brother's Rocks | 22 | 0 | 0 | 75 | 45 | 0 |
| — Kay Sal or Ragged I. | 22 | 11 | 30 | 75 | 46 | 0 |
| — Man of War Kay, North end | 22 | 17 | 20 | 75 | 48 | 40 |
| Yuma or Long Island, | | | | | | |
| — South Point | 22 | 50 | 0 | 74 | 52 | 0 |
| *Var.* 5° 0′ *E.* | | | | | | |
| — Great Harb., entr. | 23 | 6 | 0 | 74 | 52 | 30 |
| — Michael's Bank | 23 | 9 | 15 | 74 | 45 | 30 |
| — North end | 23 | 30 | 37 | 75 | 20 | 0 |
| St. Salvador or Cat I., | | | | | | |
| — Colombas or S.E. Pt | 24 | 8 | 0 | 75 | 11 | 30 |
| — Hawk's Nest, or S.W. Point | 24 | 10 | 0 | 75 | 27 | 0 |
| Little Cat I., N.W. Pt | 24 | 34 | 38 | 75 | 51 | 0 |
| Conception I., S. end | 23 | 48 | 46 | 75 | 2 | 0 |
| Southampton Reef, | | | | | | |
| — North End | 24 | 2 | 0 | 74 | 57 | 0 |
| Rum Kay, E. end | 23 | 38 | 40 | 74 | 46 | 20 |
| — West End | 23 | 39 | 0 | 74 | 56 | 35 |
| Watling's I., S.W. Pt. | 23 | 58 | 27 | 74 | 32 | 0 |
| — Rock at N. end | 24 | 10 | 30 | 74 | 24 | 30 |
| *Var.* 5° 0′ *E.* | | | | | | |
| Attwood's Kay, or Samana, E. end | 23 | 3 | 10 | 73 | 45 | 0 |
| — Western Reef | 23 | 3 | 50 | 73 | 56 | 50 |
| — Southern Reef | 23 | 1 | 45 | 73 | 51 | 0 |
| Plana or Flat Kay, mid. | 22 | 34 | 10 | 73 | 40 | 0 |
| Crooked Islands, | | | | | | |
| — Rock just above Water | 22 | 43 | 45 | 73 | 50 | 0 |
| — N. E. Reef, end | 22 | 47 | 0 | 73 | 52 | 45 |
| — N. E. Point | 22 | 44 | 30 | 73 | 54 | 20 |
| — Bird Rock | 22 | 51 | 0 | 74 | 24 | 15 |
| — Fortune I., S. Pt. | 22 | 32 | 0 | 74 | 25 | 0 |
| — Castle Island | 22 | 7 | 30 | 74 | 18 | 45 |
| Miraporvos, | | | | | | |
| — North Rock | 22 | 7 | 50 | 74 | 31 | 40 |
| — South Kay | 22 | 5 | 0 | 74 | 31 | 15 |
| — Shoal, S. E. end | 21 | 58 | 30 | 74 | 26 | 30 |
| Diana's Reef | 22 | 29 | 30 | 74 | 35 | 0 |
| Monkey Shoal | 22 | 29 | 0 | 74 | 49 | 0 |
| Mayaguana Island, | | | | | | |
| — S.W. Point | 22 | 23 | 0 | 73 | 11 | 0 |
| — East Reef | 22 | 22 | 0 | 72 | 39 | 0 |
| The [illegible] | [illegible] | | 0 | 73 | 52 | 0 |

*The Passage Islands.*

## LATITUDES AND LONGITUDES.

| (111) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *The Passage Islands.* | | | | | | |
| Great Inagua, | | | | | | |
| — N.W. Point | 21 | 8 | 0 | 73 | 38 | 0 |
| — S.W. Point | 20 | 54 | 0 | 73 | 38 | 30 |
| — S. E. Point | 20 | 59 | 0 | 73 | 6 | 0 |
| — N. E. Point | 21 | 19 | 0 | 73 | 1 | 0 |
| Statira Shoal | 20 | 55 | 0 | 73 | 1 | 0 |
| Little Inagua, | | | | | | |
| — East Point | 21 | 28 | 30 | 72 | 55 | 30 |
| — West Point | 21 | 30 | 0 | 73 | 5 | 0 |
| Caycos Reef, | | | | | | |
| — N. end of Reef | 21 | 59 | 0 | 71 | 57 | 0 |
| — W.Caycos,S.W.Pt. | 21 | 37 | 0 | 72 | 25 | 0 |
| — S.E. end of Reef | 21 | 2 | 0 | 71 | 32 | 0 |
| — N. E. end of Reef | 21 | 43 | 0 | 71 | 22 | 0 |
| Turk's Islands, | | | | | | |
| — Endymion's Rock | 21 | 6 | 0 | 71 | 15 | 0 |
| — Sand Kay, mid. | 21 | 11 | 0 | 71 | 9 | 0 |
| — Salt Kay, mid. | 21 | 20 | 0 | 71 | 8 | 0 |
| — Grand Kay, N. end | 21 | 31 | 0 | 71 | 4 | 0 |
| Square Handkerchief, | | | | | | |
| — S. W. end | 20 | 53 | 0 | 70 | 55 | 40 |
| — N. E. end | 21 | 23 | 0 | 70 | 24 | 0 |
| Silver Kay, | | | | | | |
| — N.W. end | 20 | 30 | 0 | 69 | 59 | 0 |
| — N. E. end | 20 | 31 | 0 | 69 | 26 | 0 |
| — S. E. end | 20 | 13 | 50 | 69 | 28 | 0 |
| *The Island of Cuba.* | | | | | | |
| Cape de Cruz | 19 | 47 | 16 | 77 | 40 | 30 |
| Tarquino Peak | 19 | 52 | 57 | 76 | 45 | 30 |
| St. Jago de Cuba, entr. | 19 | 57 | 29 | 76 | 2 | 45 |
| Guantanamo or Cumberland Hr., entr. | 19 | 54 | 5 | 75 | 14 | 30 |
| Escondido, E. Point | 19 | 54 | 55 | 75 | 2 | 36 |
| Baitiqueri, entrance | 20 | 2 | 0 | 74 | 50 | 0 |
| Cape Maize or Maysi | 20 | 13 | 30 | 74 | 1 | 0 |
| Mata, entrance | 20 | 17 | 10 | 74 | 12 | 30 |
| Baracoa, entrance | 20 | 20 | 50 | 74 | 21 | 0 |
| Navas, entrance | 20 | 29 | 44 | 74 | 27 | 52 |
| Taco, W. Point | 20 | 31 | 17 | 74 | 33 | 30 |
| Jaragua, entrance | 20 | 32 | 44 | 74 | 36 | 30 |
| Guarico Point | 20 | 39 | 0 | 74 | 41 | 0 |
| Cayo Mos | 20 | 42 | 18 | 74 | 49 | 0 |
| Tanamo, entrance | 20 | 42 | 41 | 75 | 14 | 0 |
| Cabonico, entrance | 20 | 42 | 11 | 75 | 23 | 40 |
| Nipe, entrance | 20 | 44 | 40 | 75 | 29 | 0 |
| Port Banes, S. E. Pt. | 20 | 52 | 50 | 75 | 36 | 0 |
| Point Mulas | 21 | 7 | 30 | 75 | 35 | 0 |
| Naranjo, entrance | 21 | 5 | 23 | 75 | 53 | 10 |
| Gibara, entrance | 21 | 6 | 12 | 76 | 7 | 0 |
| Padre, entrance | 21 | 15 | 40 | 76 | 26 | 30 |
| Manato, entrance | 21 | 23 | 44 | 76 | 44 | 0 |
| Nuevas Grandes, entr. | 21 | 26 | 50 | 76 | 51 | 0 |
| Maternillos Point | 21 | 39 | 0 | 76 | 59 | 30 |
| Cayo Romano, S.E.Pt | 21 | 53 | 0 | 77 | 36 | 0 |
| Cayo Verde | 22 | 5 | 6 | 77 | 36 | 15 |
| Cayo Confites, N. Pt. | 22 | 11 | 44 | 77 | 37 | 0 |
| Cruz del Padre | 23 | 14 | 0 | 80 | 59 | 0 |
| Matanzas, Castle | 23 | 2 | 54 | 81 | 34 | 0 |
| — Pan or Hill | 23 | 1 | 39 | 81 | 39 | 30 |
| Havanna, Light | 23 | 9 | 26 | 82 | 20 | 0 |
| Port Mariel, entrance | 23 | 5 | 58 | 82 | 39 | 31 |
| Cavanas, entrance | 23 | 4 | 0 | 82 | 52 | 30 |

| (112) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *The Island of Cuba.* | | | | | | |
| Bahia Honda, entrance | 22 | 58 | 49 | 83 | 6 | 40 |
| Cape Antonio | 21 | 54 | 0 | 84 | 57 | 30 |
| Cape Corrientes | 21 | 48 | 0 | 84 | 29 | 20 |
| Point Piedras | 21 | 56 | 30 | 83 | 50 | 0 |
| Cayo de St. Felipe, | | | | | | |
| — West end | 21 | 59 | 0 | 83 | 33 | 0 |
| Indian Kays, N. end | 21 | 54 | 30 | 83 | 15 | 0 |
| Isle of Pines, | | | | | | |
| — Point Indus | 21 | 49 | 0 | 83 | 4 | 0 |
| — Point St. Francis | 21 | 42 | 0 | 83 | 9 | 0 |
| *Var.* 9° *E.* | | | | | | |
| — Point Crocodillo | 21 | 31 | 27 | 83 | 0 | 0 |
| — East Point | 21 | 36 | 0 | 82 | 24 | 0 |
| Xagua Bay, entrance | 22 | 0 | 0 | 80 | 35 | 37 |
| Port Casilda, entrance | 21 | 35 | 25 | 80 | 2 | 0 |
| Cayo Blanco | 21 | 33 | 45 | 79 | 58 | 30 |
| Zarga de Fuera | 21 | 20 | 30 | 79 | 41 | 55 |
| Cayo Breton, S. Point | 21 | 3 | 10 | 79 | 32 | 42 |
| Roca Grande, entr. | 20 | 57 | 30 | 79 | 23 | 0 |
| *Jamaica.* | | | | | | |
| Morant Point | 17 | 58 | 0 | 76 | 6 | 0 |
| North East Point | 18 | 12 | 0 | 76 | 16 | 30 |
| Port Antonio, entr. | 18 | 16 | 0 | 76 | 23 | 0 |
| Galina Point | 18 | 29 | 30 | 76 | 54 | 0 |
| St. Anne's Bay, entr. | 18 | 31 | 0 | 77 | 16 | 0 |
| Martha Brae, entr. | 18 | 32 | 0 | 77 | 44 | 0 |
| Montego Bay, Point | 18 | 32 | 30 | 78 | 2 | 30 |
| North Negril | 18 | 24 | 0 | 78 | 30 | 0 |
| South Negril | 18 | 15 | 45 | 78 | 32 | 0 |
| John's Point | 18 | 11 | 30 | 78 | 22 | 0 |
| Savanna la Mar | 18 | 13 | 0 | 78 | 15 | 0 |
| Black River, entr. | 18 | 1 | 10 | 77 | 56 | 0 |
| Pedro Bluff | 17 | 50 | 30 | 77 | 49 | 0 |
| Portland Point | 17 | 42 | 30 | 77 | 7 | 30 |
| Kingston Church | 17 | 57 | 57 | 76 | 46 | 10 |
| Port Royal, Point | 17 | 55 | 7 | 76 | 49 | 0 |
| *Var.* 5° 50′ *E.* | | | | | | |
| Yallah Point | 17 | 52 | 0 | 76 | 28 | 0 |
| Caymanbrack, W. Pt. | 19 | 46 | 0 | 79 | 46 | 0 |
| LittleCayman,S.W.Pt | 19 | 36 | 0 | 80 | 5 | 0 |
| Grand Cayman, | | | | | | |
| — S.W. Kay or Point | 19 | 15 | 0 | 81 | 29 | 0 |
| — East End | 19 | 18 | 30 | 81 | 5 | 0 |
| *Var.* 8° 0′ *E.* | | | | | | |
| Swan Islands, S.E. Pt. | 17 | 22 | 30 | 83 | 51 | 0 |
| Baxa Nueva, | | | | | | |
| — Sandy Kay | 15 | 52 | 20 | 78 | 37 | 55 |
| Serranilla E end | 15 | 45 | 20 | 79 | 50 | 15 |
| Pedro Bank, | | | | | | |
| — Portland Rock | 17 | 7 | 30 | 77 | 26 | 0 |
| — North East Kay | 17 | 4 | 30 | 77 | 46 | 0 |
| — South Kay | 16 | 57 | 0 | 77 | 51 | 0 |
| — Rock | 16 | 48 | 0 | 78 | 12 | 0 |
| Morant Kays, | | | | | | |
| — North East Kay | 17 | 26 | 30 | 75 | 54 | 0 |
| — South West Kay | 17 | 23 | 45 | 75 | 56 | 0 |
| Formigas Bank, | | | | | | |
| — North East edge | 18 | 34 | 30 | 75 | 38 | 0 |
| — South East edge | 18 | 28 | 30 | 75 | 40 | 0 |
| — South West Edge | 18 | 28 | 0 | 75 | 48 | 0 |
| Navaza, middle | 18 | 23 | 15 | 75 | 6 | 0 |

## LATITUDES AND LONGITUDES.

| | (113) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Hayti or St. Domingo. | St. Nicholas Mole Pt. | 19 | 49 | 20 | 73 | 27 | 30 |
| | Port à Piment . . . | 19 | 35 | 0 | 72 | 57 | 3 |
| | St. Mark's Point . . | 19 | 2 | 18 | 72 | 50 | 0 |
| | Arcadins, South end . | 18 | 45 | 0 | 72 | 38 | 30 |
| | PORT AU PRINCE, | | | | | | |
| | — The Road . . . | 18 | 33 | 42 | 72 | 23 | 45 |
| | Gonave I., N. E. Pt. . | 18 | 48 | 35 | 72 | 49 | 47 |
| | — West Point. . . | 18 | 57 | 0 | 73 | 19 | 0 |
| | Petite Goave, | | | | | | |
| | Hummock . . . | 18 | 26 | 51 | 72 | 50 | 30 |
| | Rochelois Reef, | | | | | | |
| | — Pirogues . . . | 18 | 37 | 20 | 73 | 12 | 0 |
| | Point Jeremie . . . | 18 | 39 | 57 | 74 | 6 | 0 |
| | Cape Donna Maria . | 18 | 37 | 25 | 74 | 25 | 0 |
| | Point des Irois . . . | 18 | 22 | 23 | 74 | 30 | 30 |
| | CAPE TIBURON . . . | 18 | 19 | 25 | 74 | 27 | 32 |
| | Point à Gravois . . | 18 | 1 | 3 | 73 | 55 | 0 |
| | Isle à Vache, E. Pt. . | 18 | 4 | 0 | 73 | 31 | 30 |
| | Les Cayes, Town . . | 18 | 11 | 10 | 73 | 44 | 0 |
| | St. Louis, Old Fort . | 18 | 14 | 27 | 73 | 31 | 30 |
| | Aquin Bay, | | | | | | |
| | — Diamond Rock . | 18 | 13 | 48 | 73 | 20 | 0 |
| | Cape Jaquemel . . | 18 | 11 | 20 | 72 | 33 | 30 |
| | Alto Vela Rock . . | 17 | 28 | 11 | 71 | 40 | 30 |
| | Point Salinas . . . | 18 | 12 | 40 | 70 | 49 | 30 |
| | ST. DOMINGO, City . | 18 | 28 | 40 | 69 | 59 | 37 |
| | Sta. Catalina I., W. Pt. | 18 | 19 | 0 | 69 | 1 | 0 |
| | Sama I., S. E. Point . | 18 | 12 | 0 | 68 | 31 | 30 |
| | Point Espada . . . | 18 | 19 | 48 | 68 | 30 | 0 |
| | Cape Enganno . . . | 18 | 34 | 30 | 68 | 20 | 30 |
| | Cape Samana . . . | 19 | 15 | 40 | 69 | 6 | 15 |
| | Cape Cabron . . . | 19 | 22 | 0 | 69 | 12 | 50 |
| | Old Cape François . | 19 | 40 | 30 | 69 | 56 | 30 |
| | Point Isabella . . . | 19 | 58 | 43 | 71 | 12 | 0 |
| | The Grange . . . | 19 | 54 | 35 | 71 | 43 | 10 |
| | CAPE HAYTIEN, City . | 19 | 46 | 20 | 72 | 14 | 0 |
| | Tortuga Island, W. Pt. | 20 | 5 | 20 | 72 | 54 | 56 |
| | — East Point . . . | 20 | 3 | 33 | 72 | 34 | 10 |
| | Port Paix . . . . | 19 | 56 | 0 | 72 | 43 | 0 |
| | Port à L'Ecu . . . | 19 | 55 | 8 | 73 | 5 | 0 |
| Porto Rico. | Mona Island, middle . | 18 | 6 | 0 | 67 | 49 | 0 |
| | Monica . . . . . | 18 | 9 | 0 | 67 | 57 | 0 |
| | Zacheo . . . . . | 18 | 23 | 48 | 67 | 27 | 30 |
| | C. St. Juan, or N. E. Pt. | 18 | 24 | 20 | 65 | 39 | 0 |
| | ST. JUAN, Castle . . | 18 | 29 | 10 | 66 | 6 | 52 |
| | Pt. Bruquin or N. W. Pt | 18 | 31 | 18 | 67 | 7 | 0 |
| | Aguadilla Town . . | 18 | 25 | 10 | 67 | 7 | 17 |
| | Algarroba Point . . | 18 | 14 | 0 | 67 | 7 | 30 |
| | Cape Roxo . . . . | 17 | 58 | 30 | 67 | 11 | 0 |
| | Puerto Guanica . . | 17 | 57 | 44 | 66 | 52 | 45 |
| | Caxa de Muertos . . | 17 | 50 | 30 | 66 | 35 | 0 |
| Virgin Islands. | St. Thomas' Harbour, | | | | | | |
| | — Fort Christian . | 18 | 21 | 5 | 64 | 57 | 50 |
| | *Var.* 2° 30′ *E.* | | | | | | |
| | St. John's S. E. Point | 18 | 19 | 0 | 64 | 44 | 20 |
| | Virgin Gorda, E. Pt. | 18 | 31 | 7 | 64 | 21 | 30 |
| | Anegada, S. E. Point | 18 | 43 | 48 | 64 | 16 | 30 |

| | (114) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Caribbee Islands. | St. Croix or Sta. Cruz, | | | | | | |
| | — Christianstad . . | 17 | 44 | 8 | 64 | 43 | 30 |
| | Sombrero . . . . | 18 | 38 | 0 | 63 | 29 | 30 |
| | Anguilla, S. W. Point | 18 | 11 | 0 | 63 | 16 | 0 |
| | — North East Point . | 18 | 16 | 0 | 63 | 2 | 30 |
| | St. Martin, N. W. Pt. | 18 | 4 | 0 | 63 | 14 | 0 |
| | St. Bartholomew, E. Pt. | 17 | 53 | 35 | 62 | 52 | 30 |
| | Saba, middle . . . | 17 | 39 | 20 | 63 | 19 | 0 |
| | St. Eustatius, Road . | 17 | 29 | 30 | 63 | 4 | 30 |
| | St. Christopher, | | | | | | |
| | — Basse Terre . . | 17 | 19 | 30 | 62 | 49 | 15 |
| | Nevis, Town . . . | 17 | 10 | 30 | 62 | 43 | 0 |
| | Barbuda, N. Point . | 17 | 43 | 0 | 61 | 52 | 0 |
| | Antigua, | | | | | | |
| | — St. John's Road . | 17 | 9 | 40 | 61 | 57 | 0 |
| | — English Harbour . | 17 | 3 | 0 | 61 | 50 | 0 |
| | Redonda. . . . . | 16 | 55 | 30 | 62 | 26 | 0 |
| | Monserrat, N. E. Pt. . | 16 | 48 | 0 | 62 | 16 | 40 |
| | Guadaloupe, | | | | | | |
| | — Basse Terre . . | 15 | 59 | 30 | 61 | 47 | 30 |
| | — Old Fort. . . . | 15 | 56 | 0 | 61 | 45 | 30 |
| | — Chateau Point . . | 16 | 12 | 30 | 61 | 12 | 0 |
| | — North Point . . | 16 | 30 | 0 | 61 | 37 | 0 |
| | — English Head . . | 16 | 23 | 0 | 61 | 47 | 30 |
| | Deseada, N. E. Point | 16 | 20 | 0 | 61 | 6 | 30 |
| | Mariegalante, | | | | | | |
| | — Basse Terre . . | 15 | 52 | 15 | 61 | 22 | 0 |
| | Saintes, S. W. end . | 15 | 51 | 20 | 61 | 44 | 0 |
| | Dominica, | | | | | | |
| | — Pr. Rupert's Bay . | 15 | 35 | 30 | 61 | 33 | 0 |
| | — Roseau . . . . | 15 | 18 | 23 | 61 | 28 | 0 |
| | — Scot's Head . . | 15 | 12 | 0 | 61 | 26 | 0 |
| | Martinique, | | | | | | |
| | — Fort, Royal . . . | 14 | 35 | 55 | 61 | 7 | 30 |
| | — Port St. Pierre . | 14 | 44 | 0 | 61 | 15 | 0 |
| | — Macouba Point . | 14 | 54 | 0 | 61 | 18 | 30 |
| | — Saline Point . . | 14 | 23 | 0 | 60 | 58 | 0 |
| | *Var.* 2° 47′ *E.* | | | | | | |
| | — Diamond Rock . | 14 | 26 | 0 | 61 | 7 | 0 |
| | St. Lucea, | | | | | | |
| | — Careenage, entr. . | 13 | 57 | 0 | 61 | 7 | 0 |
| | — Point Piton . . | 13 | 42 | 0 | 61 | 13 | 0 |
| | — Moulacique Point | 13 | 35 | 0 | 61 | 2 | 0 |
| | St. Vincent, | | | | | | |
| | — Kington . . . . | 13 | 9 | 0 | 61 | 15 | 0 |
| | Barbadoes, | | | | | | |
| | — North Point . . | 13 | 19 | 0 | 59 | 44 | 0 |
| | — Bridgetown . . . | 13 | 5 | 30 | 59 | 43 | 15 |
| | — South Point . . | 13 | 3 | 0 | 59 | 39 | 0 |
| | Granadillos, | | | | | | |
| | — Becouya, N. Point | 13 | 3 | 0 | 61 | 13 | 0 |
| | — Cariaco, N. Point | 13 | 32 | 0 | 61 | 30 | 0 |
| | Grenada, | | | | | | |
| | — North East Point . | 12 | 14 | 0 | 61 | 42 | 0 |
| | — Fort St. George . | 12 | 2 | 54 | 61 | 49 | 40 |
| | — Point Salines . . | 11 | 58 | 0 | 61 | 52 | 0 |
| | Tobago, N. E. Point | 11 | 23 | 0 | 60 | 27 | 0 |
| | — Man of War Bay . | 11 | 22 | 0 | 60 | 32 | 0 |
| | — South West Point | 11 | 9 | 0 | 60 | 52 | 0 |
| | Trinidad, | | | | | | |
| | — Boca de Navois . | 10 | 41 | 45 | 61 | 48 | 0 |

## LATITUDES AND LONGITUDES.

| (115) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Trinidad, | | | | | | |
| — Chaguaramas Bay | 10 | 42 | 0 | 61 | 41 | 0 |
| — Port Spain | 10 | 38 | 42 | 61 | 34 | 15 |
| — Icaque Point | 10 | 4 | 0 | 61 | 59 | 30 |
| — Point Galeota | 10 | 9 | 30 | 61 | 0 | 50 |
| — Point Galera | 10 | 50 | 20 | 60 | 56 | 35 |

## XXVI. The EAST COAST of AMERICA from CAPE SABLE to DAVIS'S STRAIT.

| | | | | | | |
|---|---|---|---|---|---|---|
| *Florida Reefs.* Cape Sable | 25 | 1 | 0 | 81 | 10 | 0 |
| Tortugas Bank (5 fms) | 24 | 31 | 0 | 83 | 14 | 0 |
| Dry Tortugas, | | | | | | |
| — Kay, Light | 24 | 35 | 0 | 83 | 1 | 0 |
| Florida Reef, W. End | 24 | 20 | 0 | 82 | 39 | 0 |
| Boca Grand, entrance | 24 | 27 | 0 | 82 | 13 | 0 |
| Sand Kay, Light | 24 | 25 | 0 | 81 | 58 | 0 |
| Cayo Huesco or Thompson Island, | | | | | | |
| — West End, Light | 24 | 32 | 0 | 81 | 54 | 0 |
| Looe Kay, Tower | 24 | 33 | 30 | 81 | 30 | 0 |
| Bahia Honda, entr. | 24 | 38 | 0 | 81 | 26 | 0 |
| Sombrero Kay | 24 | 38 | 0 | 81 | 14 | 0 |
| Great Inlet, entrance | 24 | 57 | 0 | 80 | 33 | 0 |
| *East Florida.* Carysford Reef, | | | | | | |
| — Light Vessel | 25 | 3 | 0 | 80 | 29 | 0 |
| Kayo Biscayno, Light | 25 | 40 | 0 | 80 | 9 | 0 |
| Cape Florida | 25 | 46 | 0 | 80 | 4 | 0 |
| White Inlet | 25 | 51 | 0 | 80 | 6 | 0 |
| Grenville Inlet, entr. | 26 | 49 | 0 | 80 | 0 | 0 |
| Hillsborough Inlet | 27 | 14 | 0 | 80 | 8 | 0 |
| N.W. end of Matternillo Reef | 27 | 34 | 0 | 79 | 9 | 0 |
| Cape Canaveral | 28 | 17 | 0 | 80 | 25 | 0 |
| Mosquito Inlet | 28 | 56 | 0 | 80 | 53 | 0 |
| Matanza Inlet | 29 | 39 | 0 | 81 | 17 | 0 |
| St. Augustin, Light | 29 | 50 | 0 | 81 | 21 | 30 |
| St. John's River, bar | 30 | 20 | 0 | 81 | 30 | 0 |
| Nassau River, entr. | 30 | 28 | 0 | 81 | 29 | 0 |
| Cumberland I., Light | 30 | 43 | 0 | 81 | 32 | 30 |
| St. Simon's I., Light | 31 | 8 | 0 | 81 | 25 | 0 |
| Doboy or Sapello, Lt. | 31 | 24 | 0 | 81 | 17 | 0 |
| Sapello Sound, entr. | 31 | 34 | 0 | 81 | 6 | 0 |
| *South Carolina.* St. Catharine's Sound, entrance | 31 | 41 | 0 | 81 | 1 | 0 |
| Savanna, Town | 32 | 3 | 30 | 81 | 1 | 0 |
| — entr., Tybee Light | 32 | 0 | 0 | 80 | 48 | 0 |
| Beaufort | 32 | 25 | 0 | 80 | 37 | 0 |
| Charleston, Town | 32 | 45 | 34 | 79 | 57 | 30 |
| — Light | 32 | 40 | 49 | 79 | 52 | 30 |
| Cape Roman | 33 | 0 | 0 | 79 | 17 | 0 |
| Georgetown | 33 | 26 | 0 | 79 | 12 | 30 |
| — Light | 33 | 17 | 0 | 79 | 7 | 40 |
| *North Carolina.* Cape Fear, S. E. Pt. | 33 | 49 | 0 | 77 | 58 | 0 |
| — Lighthouse | 33 | 51 | 15 | 78 | 1 | 40 |
| Frying Pan Shoals, | | | | | | |
| — Outer Shoal | 33 | 36 | 0 | 77 | 50 | 0 |
| Wilmington | 34 | 14 | 0 | 77 | 58 | 0 |
| Beaufort, Town | 34 | 43 | 0 | 76 | 45 | 0 |
| Cape Lookout, Light | 34 | 39 | 0 | 76 | 37 | 0 |

| (116) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| — Shoals, S. end | 34 | 30 | 0 | 76 | 34 | 0 |
| Ocracock Inlet, Light | 35 | 5 | 0 | 75 | 59 | 0 |
| Cape Hatteras, Light | 35 | 15 | 0 | 75 | 30 | 0 |
| — Shoals, S. end | 35 | 7 | 0 | 75 | 24 | 0 |
| New or Roanoke Inlet | 35 | 37 | 0 | 75 | 26 | 0 |
| Currituck Inlet | 36 | 16 | 0 | 75 | 45 | 0 |
| Cape Henry, Light | 36 | 57 | 0 | 75 | 56 | 0 |
| Cape Charles | 37 | 9 | 30 | 75 | 54 | 0 |
| *Virginia.* Norfolk | 36 | 55 | 0 | 76 | 17 | 0 |
| New Point Comfort, Lt. | 37 | 21 | 0 | 76 | 11 | 0 |
| Smith's Point, Light | 37 | 51 | 0 | 76 | 16 | 0 |
| Cedar Point | 38 | 17 | 0 | 76 | 22 | 0 |
| Annapolis | 38 | 59 | 0 | 76 | 25 | 0 |
| Baltimore | 39 | 18 | 0 | 76 | 30 | 0 |
| WASHINGTON | 38 | 52 | 45 | 76 | 55 | 30 |
| Cape Henlopen, Light | 38 | 46 | 40 | 75 | 7 | 0 |
| *Delaware.* Cape May, Light | 38 | 57 | 0 | 74 | 55 | 45 |
| Dover | 39 | 8 | 0 | 75 | 29 | 0 |
| Wilmington | 39 | 41 | 0 | 75 | 30 | 0 |
| PHILADELPHIA | 39 | 56 | 54 | 75 | 10 | 30 |
| Great Egg Hr., entr. | 39 | 18 | 30 | 74 | 33 | 0 |
| *New Jersey.* Little Egg Hr., entr. | 39 | 30 | 0 | 74 | 20 | 0 |
| Barnegat Inlet, entr. | 39 | 47 | 30 | 74 | 7 | 0 |
| Sandy Hook, Light | 40 | 27 | 40 | 74 | 2 | 0 |
| NEW YORK, Fort | 40 | 42 | 10 | 74 | 2 | 30 |
| — City Hall | 40 | 42 | 20 | 74 | 3 | 31 |
| Frog's Point, Light | 40 | 48 | 0 | 73 | 49 | 0 |
| Sand Point, Light | 40 | 52 | 0 | 73 | 44 | 0 |
| Eaton's Neck, Light | 40 | 57 | 0 | 73 | 27 | 30 |
| Norwalk Island, Lt. | 41 | 2 | 0 | 73 | 28 | 0 |
| *Long Island Sound.* Black Rock, Light | 41 | 8 | 0 | 73 | 16 | 0 |
| Stratford Point, Light | 41 | 8 | 0 | 73 | 9 | 0 |
| Old Field Point, Lt. | 40 | 58 | 0 | 73 | 10 | 0 |
| New Haven, Light | 41 | 14 | 30 | 72 | 57 | 0 |
| Faulkland Island, Lt. | 41 | 13 | 0 | 72 | 42 | 0 |
| Saybrook, Light | 41 | 17 | 0 | 72 | 25 | 0 |
| New London, Light | 41 | 19 | 0 | 72 | 10 | 0 |
| Gull, Light | 41 | 13 | 0 | 72 | 11 | 0 |
| Watch Hill, Light | 41 | 19 | 0 | 71 | 54 | 0 |
| Montock Point, Light | 41 | 3 | 0 | 71 | 57 | 0 |
| Block I., S. E. Point | 41 | 8 | 0 | 71 | 35 | 0 |
| Point Judith, Light | 41 | 22 | 0 | 71 | 30 | 30 |
| Beaver Tail, Light | 41 | 26 | 0 | 71 | 27 | 0 |
| *Rhode Island.* Rhode Island, | | | | | | |
| — Newport, Light | 41 | 29 | 0 | 71 | 22 | 0 |
| Providence, Town | 41 | 50 | 41 | 71 | 25 | 25 |
| Buzzard Bay, Light | 41 | 24 | 0 | 70 | 59 | 0 |
| New Bedford, Light | 41 | 35 | 0 | 70 | 56 | 0 |
| Martha's Vineyard, | | | | | | |
| — Gay Head, Light | 41 | 20 | 30 | 70 | 52 | 0 |
| — North Point, Light | 41 | 28 | 30 | 70 | 37 | 0 |
| — Cape Poge, Light | 41 | 24 | 30 | 70 | 27 | 0 |
| Point Gammon, Light | 41 | 37 | 0 | 70 | 13 | 0 |
| Nantucket Island, | | | | | | |
| — Brant Town, Light | 41 | 17 | 0 | 70 | 7 | 0 |
| — Sandy Point, Lt. | 41 | 23 | 0 | 70 | 3 | 0 |
| — Tom Never's Head | 41 | 14 | 0 | 71 | 1 | 0 |
| Nantucket South Sh. | 41 | 4 | 0 | 69 | 56 | 0 |
| George's Shoals, | | | | | | |
| — S. E. part | 41 | 24 | 0 | 67 | 49 | 0 |
| — West Part | 41 | 42 | 0 | 67 | 59 | 0 |
| — N. E. part | 41 | 48 | 0 | 67 | 41 | 0 |

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## LATITUDES AND LONGITUDES.

| (117) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Massachusetts.* George's Shoals, | | | | | | |
| — North Shoal, mid. | 41 | 53 | 30 | 67 | 43 | 0 |
| — Shoal . . . . | 41 | 51 | 0 | 67 | 26 | 0 |
| — Easternmost Shoal | 41 | 47 | 0 | 67 | 19 | 0 |
| Chatham, Sandy Pt. | | | | | | |
| — South End, Light | 41 | 34 | 0 | 70 | 0 | 0 |
| Chatham Hr. Lights | 41 | 41 | 0 | 69 | 57 | 0 |
| Cape Cod, Light | 42 | 3 | 0 | 70 | 4 | 0 |
| Race Point, Light | 42 | 4 | 0 | 70 | 12 | 0 |
| Barnstaple, Light | 41 | 44 | 0 | 70 | 18 | 0 |
| Plymouth, Lights | 42 | 1 | 0 | 70 | 37 | 0 |
| Scituate, Light | 42 | 12 | 0 | 70 | 43 | 0 |
| Boston, | | | | | | |
| — Long Island, Light | 42 | 20 | 0 | 70 | 58 | 0 |
| — Town . . . . | 42 | 22 | 11 | 71 | 4 | 0 |
| Salem . . . . | 42 | 31 | 0 | 70 | 54 | 0 |
| Baker's Island, Lights | 42 | 32 | 30 | 70 | 48 | 0 |
| Cape Ann, | | | | | | |
| — Thatcher's I. Lights | 42 | 39 | 0 | 70 | 33 | 0 |
| Ipswich Hr. entrance | 42 | 42 | 0 | 70 | 45 | 0 |
| Newbury Port, | | | | | | |
| — Plumb I. Lights | 42 | 47 | 45 | 70 | 46 | 50 |
| Isle of Shoals, | | | | | | |
| — White Island, Lt. | 42 | 58 | 0 | 70 | 37 | 0 |
| Portsmouth, Light | 43 | 3 | 30 | 70 | 42 | 0 |
| Boon Island, Light | 43 | 8 | 0 | 70 | 29 | 0 |
| Cape Neddock . . | 43 | 10 | 0 | 70 | 35 | 0 |
| Cape Porpoise . . | 43 | 21 | 0 | 70 | 24 | 0 |
| Wood Island, Light | 43 | 27 | 0 | 70 | 19 | 0 |
| *Maine.* Casco Bay, | | | | | | |
| — Cape Elizabeth | 43 | 33 | 0 | 70 | 11 | 0 |
| — Portland, Light | 43 | 36 | 30 | 70 | 11 | 30 |
| — Halfway Rock . | 43 | 37 | 0 | 70 | 1 | 0 |
| Cashes Ledge, middle | 43 | 2 | 0 | 69 | 6 | 0 |
| Seguin Island, Light | 43 | 40 | 30 | 69 | 43 | 30 |
| Pond Island, Light | 43 | 42 | 30 | 69 | 43 | 30 |
| John's Bay, | | | | | | |
| — Penmaquid I., Lt. | 43 | 48 | 0 | 69 | 26 | 0 |
| Franklin's I., Light | 43 | 54 | 0 | 69 | 13 | 0 |
| Manheigin I., Light | 43 | 45 | 0 | 69 | 11 | 0 |
| Mitinick Rock . . | 43 | 52 | 0 | 68 | 59 | 0 |
| White Head, Light | 43 | 59 | 0 | 68 | 58 | 0 |
| Owl's Head, Light | 44 | 5 | 0 | 68 | 55 | 0 |
| Castine, Town . . | 44 | 24 | 0 | 68 | 38 | 0 |
| Haute Island, S. Pt. | 44 | 1 | 0 | 68 | 30 | 0 |
| Mount Desert Rock | 43 | 52 | 0 | 68 | 8 | 30 |
| Petit Manan I., Light | 44 | 24 | 0 | 67 | 46 | 0 |
| Moose Peck Hd., Lt. | 44 | 33 | 0 | 67 | 27 | 0 |
| Libee Islands, Light | 44 | 38 | 0 | 67 | 18 | 0 |
| Machias Town . . . | 44 | 51 | 0 | 67 | 23 | 0 |
| Passamaquady Hd. Lt. | 44 | 48 | 40 | 66 | 56 | 0 |
| Head Harbour, Light | 44 | 56 | 50 | 66 | 52 | 58 |
| Grand Manan Island, | | | | | | |
| — North Point . . | 44 | 46 | 49 | 66 | 45 | 7 |
| — South West Head | 44 | 36 | 0 | 66 | 51 | 0 |
| — Grand Harb., entr | 44 | 39 | 0 | 66 | 43 | 0 |
| White Head I., S. Pt. | 44 | 36 | 59 | 66 | 41 | 4 |
| Old Proprietor Rock | 44 | 32 | 30 | 66 | 36 | 0 |
| Gannet Rock . . . | 44 | 31 | 0 | 66 | 46 | 0 |
| *New Brunswick.* Machias Seal Islands, | | | | | | |
| — N. E. part . . . | 44 | 31 | 0 | 66 | 58 | 30 |
| St. Andrews, Town | 15 | 3 | 30 | 67 | 1 | 0 |

| (118) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Wolf Islands, N.E.end | 44 | 59 | 0 | 66 | 42 | 0 |
| Beaver Harbour, entr. | 45 | 3 | 12 | 66 | 43 | 28 |
| Point Lepreau . . | 45 | 3 | 0 | 66 | 27 | 0 |
| St. John's Town . . | 45 | 15 | 0 | 66 | 2 | 19 |
| Partridge Island, Lt. | 45 | 13 | 36 | 66 | 2 | 0 |
| Cape Maspeck . . . | 45 | 12 | 30 | 65 | 59 | 15 |
| Cape Spencer . . . | 45 | 12 | 0 | 65 | 52 | 0 |
| Quaki Ledge, middle | 45 | 13 | 30 | 65 | 11 | 0 |
| Cape Enragée . . . | 45 | 30 | 0 | 64 | 33 | 0 |
| Fort Cumberland . . | 45 | 44 | 0 | 64 | 9 | 0 |
| Cape Chignecto . . | 45 | 18 | 0 | 64 | 49 | 30 |
| Cape Split . . . . | 45 | 17 | 30 | 64 | 22 | 0 |
| Haute Island . . . | 45 | 14 | 0 | 64 | 54 | 0 |
| Annapolis, | | | | | | |
| — Pt. Prim or Digby | | | | | | |
| Light . . . . | 44 | 40 | 25 | 65 | 46 | 15 |
| Bryer's Island, Light | 44 | 13 | 51 | 66 | 22 | 54 |
| Cape St. Mary . . . | 44 | 4 | 15 | 66 | 11 | 0 |
| Cape Fourchu . . . | 43 | 48 | 0 | 66 | 9 | 0 |
| Gannet Rock . . . | 43 | 37 | 30 | 66 | 6 | 0 |
| Seal Island, S. Point | 43 | 23 | 51 | 65 | 55 | 42 |
| — North Point . . | 43 | 26 | 22 | 65 | 57 | 38 |
| Blond Rock . . . | 43 | 20 | 30 | 65 | 55 | 15 |
| Cape Sable, S. Point | 43 | 23 | 57 | 65 | 34 | 3 |
| *Var.* 13° 24′ *W.* | | | | | | |
| Brazil Rock . . . . | 43 | 21 | 30 | 65 | 22 | 0 |
| Cape Negro . . . . | 43 | 29 | 0 | 65 | 18 | 0 |
| Shelburne . . . . | 43 | 44 | 30 | 65 | 17 | 0 |
| Cape Roseway, Light | 43 | 37 | 31 | 65 | 14 | 40 |
| Rugged Island, S.E.Pt | 43 | 41 | 14 | 64 | 59 | 44 |
| — Sandy Point . . | 43 | 41 | 57 | 65 | 18 | 11 |
| Little Hope Island . | 43 | 48 | 34 | 64 | 45 | 48 |
| *Nova Scotia.* Mouton Island, S. Pt. | 43 | 55 | 0 | 64 | 44 | 0 |
| Liverpool Bay, | | | | | | |
| Western Head . . | 43 | 59 | 18 | 64 | 38 | 35 |
| Liverpool, Coffin I. Lt | 44 | 1 | 52 | 64 | 36 | 49 |
| *Var.* 14° 43′ *W.* | | | | | | |
| Port Metway, S.W. Hd. | 44 | 6 | 24 | 64 | 31 | 9 |
| Indian Island . . . | 44 | 9 | 40 | 64 | 22 | 51 |
| Cape Le Heve . . . | 44 | 11 | 8 | 64 | 19 | 43 |
| Le Heve Rock . . . | 44 | 10 | 50 | 64 | 18 | 25 |
| Lunenburg Bay, | | | | | | |
| — Cross Island, S. Pt. | 44 | 19 | 30 | 64 | 8 | 45 |
| — Point Rose . . . | 44 | 18 | 7 | 64 | 11 | 33 |
| Green Island . . . | 44 | 28 | 30 | 64 | 1 | 0 |
| Cape Prospect . . . | 44 | 26 | 38 | 63 | 42 | 39 |
| Sambro, Light . . . | 44 | 26 | 17 | 63 | 31 | 16 |
| Halifax, Naval Yard | 44 | 39 | 26 | 63 | 33 | 48 |
| *Var.* 17° 10′ *W.* | | | | | | |
| Jedore Head . . . | 44 | 40 | 5 | 63 | 1 | 10 |
| Owl's Head . . . . | 44 | 43 | 0 | 62 | 48 | 0 |
| Tangier Island . . . | 44 | 44 | 28 | 62 | 37 | 7 |
| Spry Harbour, | | | | | | |
| — Taylor's Head . . | 44 | 44 | 0 | 62 | 20 | 0 |
| Outer Beaver I., S.E.Pt | 44 | 48 | 24 | 62 | 17 | 43 |
| White Island, E. end | 44 | 50 | 30 | 62 | 2 | 0 |
| Liscombe Harbour, | | | | | | |
| — South West Point . | 44 | 55 | 0 | 61 | 54 | 0 |
| Green Island, S. Pt. . | 45 | 4 | 55 | 61 | 34 | 49 |
| Berry Head . . . . | 45 | 10 | 44 | 61 | 17 | 9 |
| White Head Island . | 45 | 10 | 17 | 61 | 5 | 49 |
| Cape Canso . . . | 45 | 16 | 0 | 60 | 56 | 0 |

## LATITUDES AND LONGITUDES.

| (119) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Cranberry Island, Lt | 45 | 19 | 33 | 60 | 54 | 38 |
| Sable Island, W. end | 43 | 56 | 30 | 60 | 9 | 34 |
| — East end | 43 | 59 | 15 | 59 | 44 | 17 |
| — Southernmost part | 43 | 55 | 0 | 59 | 54 | 0 |
| Gut of Canso, | | | | | | |
| — Eddy Point | 45 | 30 | 25 | 61 | 12 | 54 |
| — Ship Harbour | 45 | 36 | 25 | 61 | 17 | 43 |
| Isle Madame, | | | | | | |
| — Cape Hogan | 45 | 27 | 0 | 61 | 1 | 0 |
| Green Island | 45 | 27 | 47 | 60 | 53 | 48 |
| Cape Portland | 45 | 47 | 57 | 60 | 3 | 36 |
| Cape Hinchinbroke | 45 | 34 | 29 | 60 | 38 | 36 |
| Louisbourg, | | | | | | |
| — Old Lighthouse | 45 | 53 | 31 | 59 | 55 | 48 |
| Cape Breton | 45 | 56 | 26 | 59 | 46 | 15 |
| Scateri Island, E. Pt. | 46 | 1 | 19 | 59 | 39 | 29 |
| Cape Granby | 46 | 9 | 18 | 59 | 49 | 0 |
| *Var. 22° 27′ W.* | | | | | | |
| Flint Island | 46 | 10 | 0 | 59 | 47 | 0 |
| St. Ann's Bay, | | | | | | |
| — Siboux Is., S. end | 46 | 24 | 20 | 60 | 25 | 30 |
| Naganish Island | 46 | 44 | 0 | 60 | 22 | 0 |
| Cape North | 47 | 2 | 13 | 60 | 22 | 53 |
| Chetican Harb., entr. | 46 | 39 | 0 | 60 | 59 | 0 |
| Sea Wolf Island | 46 | 22 | 30 | 61 | 14 | 0 |
| Just aux Corp I., S. Pt. | 45 | 58 | 10 | 61 | 33 | 51 |
| Cape Linzee | 45 | 59 | 31 | 61 | 32 | 15 |
| *Var. 21° 14′ W.* | | | | | | |
| Port Hood, entrance | 45 | 58 | 0 | 61 | 30 | 0 |
| East Point | 46 | 27 | 36 | 61 | 56 | 8 |
| George Town | 46 | 10 | 30 | 62 | 28 | 0 |
| Bear Cape | 46 | 0 | 2 | 62 | 25 | 57 |
| Charlotte Town | 46 | 15 | 0 | 63 | 10 | 0 |
| Cape Traverse | 46 | 13 | 37 | 63 | 38 | 47 |
| Cape Egmont | 46 | 26 | 0 | 64 | 7 | 0 |
| West Cape | 46 | 37 | 48 | 64 | 20 | 21 |
| North Cape | 47 | 4 | 20 | 64 | 0 | 15 |
| Richmond Bay, entr. | 46 | 36 | 30 | 63 | 48 | 0 |
| New London | 46 | 33 | 0 | 63 | 35 | 0 |
| St. Peter's Harb., entr. | 46 | 29 | 0 | 62 | 52 | 0 |
| Gut of Canso, | | | | | | |
| — North entrance | 45 | 42 | 0 | 61 | 26 | 0 |
| Cape St. George | 45 | 51 | 22 | 61 | 51 | 12 |
| Merigomish Harb. ent. | 45 | 40 | 0 | 62 | 26 | 0 |
| Pictou Island, | | | | | | |
| — South end | 45 | 47 | 52 | 62 | 33 | 33 |
| *Var. 19° 35′ W.* | | | | | | |
| Pictou Harbour | 45 | 41 | 56 | 62 | 38 | 0 |
| — Academy | 45 | 40 | 20 | 62 | 40 | 28 |
| Tatmagouche, | | | | | | |
| — Amet Island | 45 | 49 | 0 | 63 | 8 | 0 |
| Cape Tormentin, | | | | | | |
| — N. E. Point | 46 | 7 | 38 | 63 | 47 | 42 |
| Richibucto Harb., ent. | 46 | 44 | 0 | 64 | 47 | 0 |
| Miramiche Bay, | | | | | | |
| — Point Escuminac | 47 | 5 | 2 | 64 | 49 | 30 |
| Chaleur Bay, | | | | | | |
| — Point Miscou | 48 | 1 | 27 | 64 | 31 | 49 |
| — Point Paspibiac | 48 | 0 | 54 | 65 | 14 | 17 |

| (120) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Chaleur Bay, | | | | | | |
| — Cape Despair | 48 | 25 | 0 | 64 | 23 | 0 |
| Nipisighet Bay, | | | | | | |
| — Caron Point | 47 | 37 | 0 | 65 | 34 | 0 |
| Bonaventure Island, | | | | | | |
| — N.W. Point | 48 | 29 | 30 | 64 | 14 | 37 |
| Flat Point | 48 | 36 | 0 | 64 | 11 | 0 |
| Cape Gaspé, S. E. Pt. | 48 | 45 | 14 | 64 | 9 | 38 |
| *Var. 21° 38′ W.* | | | | | | |
| Gaspé Bay, | | | | | | |
| — Douglas Town | 48 | 46 | 33 | 64 | 21 | 18 |
| Cape Rosier | 48 | 50 | 41 | 64 | 11 | 24 |
| Magdalen River, entr | 49 | 13 | 0 | 65 | 6 | 0 |
| Cape Chat | 49 | 4 | 0 | 66 | 35 | 0 |
| Bic Island | 48 | 26 | 0 | 68 | 49 | 0 |
| Green Island, Light | 48 | 2 | 0 | 69 | 20 | 0 |
| Anticosta I., East Pt. | 49 | 8 | 30 | 61 | 40 | 57 |
| *Var. 24° 38′ W.* | | | | | | |
| — South Point | 49 | 4 | 0 | 62 | 10 | 0 |
| — South West Point | 49 | 27 | 0 | 63 | 35 | 0 |
| — Jupiter's R., entr. | 49 | 32 | 0 | 63 | 38 | 0 |
| — West Point | 49 | 52 | 29 | 64 | 32 | 55 |
| *Var. 22° 55′ W.* | | | | | | |
| — North Point | 49 | 57 | 38 | 64 | 11 | 1 |
| Magdalen Islands, | | | | | | |
| — North East Point | 47 | 37 | 37 | 61 | 22 | 51 |
| — Amherst I., S.W. Pt | 47 | 12 | 0 | 62 | 5 | 0 |
| — Entry I., S.W. Pt. | 47 | 16 | 7 | 61 | 43 | 26 |
| *Var. 22° 25′ W.* | | | | | | |
| — Deadman's Island | 47 | 16 | 0 | 62 | 17 | 0 |
| Biron Island, N.E. Pt. | 47 | 48 | 0 | 61 | 25 | 0 |
| Bird's Island | 47 | 50 | 28 | 61 | 8 | 53 |
| St. Paul's Island | 47 | 12 | 38 | 60 | 7 | 24 |
| Cape Ray | 47 | 37 | 3 | 59 | 17 | 2 |
| Cape Anguille | 47 | 55 | 0 | 59 | 24 | 20 |
| Cape St. George | 48 | 28 | 54 | 59 | 14 | 26 |
| Bay of Islands, | | | | | | |
| — South Head | 49 | 6 | 12 | 58 | 20 | 32 |
| Cow Head | 49 | 55 | 12 | 57 | 51 | 16 |
| Ingornachoix Bay, | | | | | | |
| — Port Saunders, ent. | 50 | 38 | 30 | 57 | 18 | 0 |
| Point Riche | 50 | 41 | 30 | 57 | 24 | 0 |
| St. John's I., Bay | 50 | 47 | 30 | 57 | 16 | 0 |
| Point Ferolle | 51 | 1 | 9 | 57 | 5 | 47 |
| Bay St. Barbe, | | | | | | |
| — Anchor Point | 51 | 14 | 0 | 56 | 45 | 0 |
| Seal Islands | 51 | 17 | 0 | 56 | 43 | 0 |
| Green Island | 51 | 24 | 0 | 56 | 29 | 0 |
| Cape Norman | 51 | 37 | 0 | 55 | 48 | 0 |
| Burnt Cape | 51 | 35 | 0 | 55 | 38 | 0 |
| Cape Onion | 51 | 36 | 30 | 55 | 31 | 0 |
| Quirpon Island, | | | | | | |
| — Cape Bauld | 51 | 38 | 0 | 55 | 30 | 0 |
| Belle Island, S. Point | 51 | 52 | 26 | 55 | 19 | 30 |
| Griguet Bay | 51 | 32 | 30 | 55 | 21 | 30 |
| St Lunaire Bay, | | | | | | |
| — White Cape | 51 | 30 | 25 | 55 | 21 | 33 |
| *Var. 32° 0′ W.* | | | | | | |
| Bruha Harbour, | | | | | | |
| — Needles Rocks | 51 | 26 | 5 | 55 | 22 | 45 |
| *Var. 34° 0′ W.* | | | | | | |

*Breton Island.* *Prince Edward's Island.* *New Brunswick.* *Gulf of St. Lawrence.* *Newfoundland.*

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## LATITUDES AND LONGITUDES.

| | (121) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Island of Newfoundland. | St. Anthony's Harb. | 51 | 21 | 0 | 55 | 28 | 0 |
| | Goose Cape | 51 | 17 | 0 | 55 | 32 | 0 |
| | Hare Bay, — How Harbour | 51 | 20 | 0 | 55 | 51 | 0 |
| | — Hare Island | 51 | 20 | 0 | 55 | 56 | 0 |
| | Croc Harbour | 51 | 3 | 0 | 55 | 41 | 0 |
| | Cape Rouge | 50 | 57 | 0 | 55 | 44 | 0 |
| | Rouge Island, N. Pt. | 50 | 54 | 0 | 55 | 42 | 0 |
| | Grouis Island, N. Pt. | 50 | 59 | 0 | 55 | 27 | 0 |
| | Belle Island, N. Point | 50 | 48 | 0 | 55 | 23 | 0 |
| | Green Island | 50 | 44 | 0 | 55 | 35 | 0 |
| | Canada Head | 50 | 41 | 0 | 56 | 2 | 0 |
| | Spear Point | 49 | 44 | 0 | 56 | 45 | 0 |
| | Partridge Point | 50 | 9 | 30 | 56 | 4 | 0 |
| | Fleur de Lis Harbour | 50 | 6 | 40 | 56 | 2 | 10 |
| | Pacquet Harbour | 49 | 58 | 30 | 55 | 45 | 0 |
| | La Scie Harbour | 49 | 58 | 0 | 55 | 30 | 30 |
| | Cape St. John, — North Bill | 49 | 59 | 30 | 55 | 25 | 0 |
| | Gull Island | 49 | 59 | 30 | 55 | 16 | 0 |
| | Nipper's Harbour, — Seal Island, E. Pt. | 49 | 47 | 0 | 55 | 46 | 8 |
| | *Var.* 28° 0′ *W.* | | | | | | |
| | Ring Island, — Cutwell's Harbour | 49 | 37 | 0 | 55 | 34 | 0 |
| | Triton Harbour, — Francis Island | 49 | 33 | 0 | 55 | 31 | 0 |
| | Fortune Harbour | 49 | 32 | 0 | 55 | 10 | 0 |
| | Toulinguet Harbour, — Harbour Rock | 49 | 39 | 28 | 54 | 41 | 20 |
| | *Var.* 30° 0′ *W.* | | | | | | |
| | Change Islands, — Tobacco Island | 49 | 41 | 35 | 54 | 18 | 10 |
| | Fogo Island, Harbour — Lanes I., E. Point | 49 | 44 | 25 | 54 | 11 | 30 |
| | — Cape Fogo | 49 | 40 | 0 | 53 | 54 | 0 |
| | Wadham Islands, — Offer Wadham | 49 | 37 | 30 | 53 | 40 | 0 |
| | Funk Island | 49 | 44 | 21 | 53 | 7 | 20 |
| | Cape Freels, — South Bill | 49 | 18 | 40 | 53 | 24 | 0 |
| | Greenspond Island | 49 | 7 | 30 | 53 | 31 | 0 |
| | Offer Gooseberry I. | 48 | 58 | 30 | 53 | 27 | 0 |
| | Barrow Harbour | 48 | 39 | 0 | 53 | 34 | 0 |
| | Black Head Bay, — Southern Head | 48 | 37 | 15 | 53 | 16 | 0 |
| | Young Harry Reef | 48 | 48 | 5 | 52 | 58 | 15 |
| | Cape Bonavista, — Gull Island | 48 | 42 | 40 | 52 | 59 | 20 |
| | CatalinaHarb.N.Head | 48 | 32 | 28 | 52 | 56 | 6 |
| | Horsechops | 48 | 21 | 30 | 53 | 8 | 30 |
| | Trinity Harbour, entr. | 48 | 21 | 30 | 53 | 16 | 50 |
| | Bonaventure Head | 48 | 16 | 30 | 53 | 18 | 10 |
| | Bacalieu Island, N.Pt. | 48 | 9 | 0 | 52 | 44 | 46 |
| | Cape St. Francis | 47 | 48 | 4 | 52 | 48 | 41 |
| | St. John's Harb. Ch. | 47 | 34 | 35 | 52 | 38 | 37 |
| | Cape Spear | 47 | 30 | 53 | 52 | 38 | 30 |
| | Bull Head | 47 | 18 | 0 | 52 | 41 | 19 |
| | Cape Broyle, N. Pt. | 47 | 3 | 52 | 52 | 47 | 27 |
| | Cape Ballard | 46 | 46 | 46 | 52 | 53 | 20 |
| | CAPE RACE | 46 | 39 | 44 | 52 | 59 | 10 |
| | Virgin Rocks | 46 | 26 | 33 | 50 | 56 | 35 |

| | (122) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | ° | ′ | ″ |
| Island of Newfoundland. | Trepassey Bay, — Cape Pine | 46 | 37 | 14 | 53 | 30 | 0 |
| | Point Lance | 46 | 47 | 0 | 54 | 0 | 0 |
| | Cape St. Mary | 46 | 49 | 25 | 54 | 8 | 45 |
| | Point Breme | 46 | 58 | 0 | 54 | 11 | 0 |
| | Placentia Harbour | 47 | 15 | 11 | 53 | 55 | 3 |
| | Little Southern Harb. | 47 | 43 | 32 | 53 | 54 | 38 |
| | Bordeaux Harbour | 47 | 45 | 28 | 53 | 58 | 30 |
| | Mortier Bay, entrance | 47 | 4 | 30 | 55 | 1 | 0 |
| | Mortier Rocks, mid. | 47 | 2 | 0 | 54 | 52 | 0 |
| | Cape Chapeaurouge | 46 | 54 | 19 | 55 | 20 | 30 |
| | Point May | 46 | 54 | 0 | 55 | 59 | 0 |
| | St. Peter's I., Lighth. | 46 | 46 | 52 | 56 | 8 | 44 |
| | Little Miquelon, S.Pt. | 46 | 47 | 0 | 56 | 19 | 0 |
| | Cape Miquelon | 47 | 8 | 11 | 56 | 19 | 30 |
| | Connaigre Shoal | 47 | 23 | 57 | 55 | 57 | 19 |
| | Pass Island | 47 | 29 | 2 | 56 | 11 | 18 |
| | Outer Penguin Is. | 47 | 22 | 9 | 56 | 58 | 7 |
| | Cape La Hune | 47 | 31 | 55 | 56 | 50 | 23 |
| | Burgeo Is., Eclipse I. | 47 | 36 | 6 | 57 | 36 | 15 |
| | Connoire Bay | 47 | 40 | 0 | 58 | 0 | 0 |
| Canada. | QUEBEC | 46 | 47 | 30 | 71 | 10 | 0 |
| | Coudre I., N.E. Point | 47 | 25 | 0 | 70 | 13 | 0 |
| | St. Paul | 47 | 26 | 0 | 70 | 22 | 0 |
| | Malbay | 47 | 37 | 0 | 70 | 3 | 0 |
| | Bay of Rocks | 47 | 57 | 0 | 69 | 43 | 0 |
| | Point Mille Vache | 48 | 32 | 0 | 69 | 5 | 0 |
| | Manicougan Point | 49 | 6 | 0 | 68 | 5 | 0 |
| | Bold Mountain's Pt. | 49 | 19 | 0 | 67 | 10 | 0 |
| Esquimaux. | The Seven Islands, — Carousal Island | 50 | 5 | 0 | 66 | 11 | 0 |
| | Mingan Island | 50 | 12 | 0 | 64 | 3 | 0 |
| | Esquimaux Islands, — St. Genevieve I. | 50 | 16 | 0 | 63 | 1 | 0 |
| | Mount Joli | 50 | 6 | 0 | 61 | 37 | 0 |
| | Little Mecatina | 50 | 50 | 0 | 59 | 15 | 0 |
| | Great Mecatina Point | 50 | 44 | 28 | 58 | 59 | 27 |
| | Green Island | 51 | 24 | 0 | 57 | 11 | 0 |
| | Forteaux Point | 51 | 27 | 0 | 56 | 54 | 0 |
| | Ship Head | 51 | 37 | 0 | 56 | 38 | 0 |
| Labradore. | Red Bay, — Saddle Island | 51 | 42 | 40 | 56 | 21 | 0 |
| | York Point | 51 | 55 | 0 | 56 | 42 | 0 |
| | Belle Island, S.W. Pt. | 51 | 52 | 26 | 55 | 19 | 31 |
| | — N.E. Point | 52 | 0 | 33 | 55 | 11 | 30 |
| | Cape Charles | 52 | 12 | 18 | 55 | 31 | 1 |
| | Sandwich Bay, — Huntingdon Island | 53 | 50 | 0 | 56 | 30 | 0 |
| | Nain | 56 | 24 | 0 | 61 | 48 | 0 |
| | Port Manvers | 56 | 58 | 0 | 62 | 0 | 0 |
| | *Var.* 41° 15′ *W.* | | | | | | |
| Hudson's Strait. | Button's Isles | 60 | 45 | 0 | 64 | 55 | 0 |
| | Resolution I., S. Pt. | 61 | 20 | 40 | 64 | 55 | 15 |
| | Cape Resolution | 61 | 39 | 0 | 64 | 30 | 0 |
| | LowerSavage Is., S.Pt. | 61 | 40 | 0 | 66 | 7 | 0 |
| | Saddleback Island | 62 | 11 | 0 | 67 | 43 | 0 |
| | Upper Savage Islands | 62 | 32 | 30 | 69 | 58 | 0 |
| | Salisbury Island, N.Pt. | 63 | 47 | 0 | 77 | 18 | 0 |
| | King's Cape | 64 | 23 | 0 | 77 | 46 | 0 |
| | Trinity Islands | 64 | 27 | [illegible] | [illegible] | [illegible] | 0 |
| | Cape Comfort | 64 | [illegible] | [illegible] | [illegible] | [illegible] | 0 |

## LATITUDES AND LONGITUDES.

| (123) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| *Frozen Strait.* | | | | | | |
| Cape Welsford | 65 | 28 | 0 | 84 | 40 | 0 |
| *Var.* 50° 18′ *W.* | | | | | | |
| D. of York's Bay, anch. | 65 | 19 | 0 | 85 | 1 | 0 |
| Cape Frigid | 65 | 59 | 30 | 85 | 25 | 0 |
| Repulse Bay | 66 | 30 | 58 | 86 | 30 | 20 |
| *Var.* 48° 33′ *W.* | | | | | | |
| Cape MacLaren | 66 | 9 | 40 | 84 | 2 | 40 |
| Cape Martineau | 66 | 9 | 30 | 83 | 54 | 20 |
| Vansittart I., N.E. Pt. | 66 | 7 | 10 | 84 | 16 | 0 |
| Baffin's I., S. E. Pt. | 65 | 40 | 0 | 83 | 29 | 0 |
| Winter Island, S. Pt. | 66 | 11 | 25 | 83 | 10 | 0 |
| *Var.* 56° 18′ *W.* | | | | | | |
| Lyon Inlet, | | | | | | |
| — Cape Edwards | 66 | 18 | 40 | 83 | 38 | 30 |
| Owlitteweek Island | 66 | 58 | 30 | 81 | 36 | 0 |
| *Var.* 62° 17′ *W.* | | | | | | |
| Barrow River, entr. | 67 | 18 | 0 | 81 | 25 | 0 |
| *Var.* 70° 28′ *W.* | | | | | | |
| Cape Penrhyn | 67 | 24 | 40 | 81 | 19 | 0 |
| Cape Jermain | 67 | 47 | 30 | 81 | 58 | 30 |
| Ooglet Island, S. Pt. | 68 | 23 | 0 | 81 | 32 | 0 |
| Igloolik I., S.E. Point | 69 | 20 | 40 | 81 | 31 | 0 |
| Neirloomakto I., N.Pt. | 69 | 33 | 0 | 81 | 41 | 0 |
| *Var.* 87° 20′ *W.* | | | | | | |
| Bouverie Is., E. Pt. | 69 | 36 | 30 | 82 | 1 | 0 |
| *Var.* 88° 51′ *W.* | | | | | | |
| Liddon's I., S. Point | 69 | 45 | 0 | 83 | 6 | 0 |
| Amherst I., N. E. Pt. | 69 | 48 | 0 | 83 | 35 | 0 |
| *Var.* 89° 18′ *W.* | | | | | | |
| *Fury and Hecla Strait.* | | | | | | |
| Cape Hallowell | 69 | 57 | 40 | 85 | 25 | 0 |
| Cape Englefield | 69 | 51 | 0 | 85 | 30 | 0 |
| C. Wolstenholm or Walsingham | 62 | 39 | 0 | 77 | 48 | 0 |
| Cape Digges | 62 | 41 | 0 | 78 | 50 | 0 |
| Salisbury Island | 63 | 29 | 0 | 76 | 47 | 0 |
| Mansfield Island, | | | | | | |
| — North Point | 62 | 38 | 30 | 80 | 33 | 0 |
| — South Point | 61 | 35 | 0 | 81 | 0 | 0 |
| Cape Southampton | 61 | 56 | 0 | 83 | 52 | 0 |
| Cape Pembroke | 62 | 57 | 0 | 81 | 15 | 0 |
| North Sleepers | 61 | 0 | 0 | 78 | 15 | 0 |
| West Sleepers, N. end | 60 | 15 | 0 | 81 | 35 | 0 |
| Portland Point | 59 | 0 | 0 | 78 | 30 | 0 |
| Belchers, N. Point | 56 | 20 | 0 | 80 | 15 | 0 |
| *Hudson's Bay.* | | | | | | |
| James's Bay, | | | | | | |
| — C. Henrietta Maria | 55 | 10 | 0 | 82 | 30 | 0 |
| — Cape Jones | 54 | 50 | 0 | 78 | 54 | 0 |
| — Bear Isle | 54 | 34 | 0 | 81 | 24 | 0 |
| — North Cubb | 54 | 20 | 0 | 80 | 48 | 0 |
| — The Twins | 53 | 12 | 0 | 80 | 35 | 0 |
| — Albany Fort | 52 | 14 | 40 | 82 | 0 | 0 |
| — Moose Fort | 51 | 15 | 54 | 80 | 56 | 24 |
| — East Main House | 52 | 15 | 0 | 78 | 44 | 30 |
| — Charlton Island | 52 | 3 | 0 | 80 | 8 | 0 |
| York Factory | 57 | 0 | 3 | 92 | 26 | 0 |
| Cape Churchill | 58 | 50 | 0 | 93 | 4 | 0 |
| Fort Churchill | 58 | 47 | 32 | 94 | 13 | 55 |
| Marble Island | 62 | 33 | 0 | 91 | 6 | 0 |
| Sir T. Rowe's Welcome | | | | | | |
| — Cape Fullerton | 63 | 50 | 0 | 88 | 15 | 0 |
| — Cape Kendall | 63 | 40 | 0 | 87 | 15 | 0 |

| (124) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Bay of God's Mercy | 63 | 35 | 48 | 86 | 32 | 0 |
| *Davis's Strait.* | | | | | | |
| Charles Island | 63 | 0 | 0 | 64 | 50 | 0 |
| Cape Enderby | 63 | 45 | 0 | 65 | 30 | 0 |
| Sanderson's Tower | 64 | 50 | 0 | 63 | 44 | 0 |
| Cape Mickleham | 65 | 18 | 0 | 62 | 50 | 0 |
| Cape Dacres | 65 | 36 | 0 | 61 | 59 | 0 |
| Cape Walsingham | 66 | 4 | 0 | 60 | 51 | 0 |
| Mount Raleigh | 66 | 30 | 0 | 61 | 30 | 0 |
| Dyer's Cape | 66 | 42 | 0 | 61 | 6 | 0 |
| Cape Broughton | 67 | 47 | 0 | 63 | 30 | 0 |
| Cape Hooper | 68 | 6 | 0 | 64 | 36 | 0 |
| Cape Bisson | 69 | 10 | 0 | 66 | 50 | 0 |
| Cape Kater | 69 | 42 | 0 | 67 | 25 | 0 |
| Cape Roper | 70 | 5 | 0 | 67 | 20 | 0 |
| River Clyde, | | | | | | |
| — Cape Hewett | 70 | 27 | 0 | 67 | 58 | 0 |
| — Agnes Monument | 70 | 37 | 0 | 68 | 0 | 0 |
| Cape Eglinton | 70 | 49 | 0 | 69 | 10 | 0 |
| Scott's Bay | 71 | 10 | 0 | 71 | 10 | 0 |
| Cape Bowen | 72 | 25 | 0 | 74 | 40 | 0 |
| Cape Graham Moore | 72 | 54 | 0 | 76 | 5 | 0 |
| Cape Byam Martin | 73 | 25 | 0 | 76 | 40 | 0 |
| *Var.* 90° *W.* | | | | | | |
| Cape Liverpool | 73 | 44 | 0 | 78 | 10 | 0 |
| Cape Hay | 73 | 50 | 0 | 79 | 55 | 0 |
| Lancaster Sound, | | | | | | |
| — Entrance, about | 74 | 19 | 0 | 80 | 0 | 0 |
| Wollaston Islands | 73 | 49 | 0 | 80 | 57 | 0 |
| Cape Charles York | 73 | 53 | 0 | 82 | 52 | 0 |
| Cape York | 73 | 50 | 0 | 86 | 55 | 0 |
| Prince Regent's Inlet | | | | | | |
| — Port Bowen | 73 | 13 | 39 | 88 | 54 | 49 |
| *Var.* 123° 22′ *W.* | | | | | | |
| — Neill's Harbour | 73 | 9 | 8 | 89 | 1 | 20 |
| *Var.* 118° 48′ *W.* | | | | | | |
| — Cape Kater | 71 | 55 | 0 | 90 | 5 | 0 |
| — Cape Garry | 72 | 23 | 0 | 93 | 17 | 0 |
| — Fury's Wreck | 72 | 42 | 30 | 91 | 50 | 5 |
| — Cape Sepping | 73 | 47 | 0 | 90 | 15 | 0 |
| Prince Leopold's Is., | | | | | | |
| — East end | 74 | 2 | 0 | 89 | 50 | 0 |
| Griffith's I., S. E. Pt. | 74 | 31 | 0 | 95 | 24 | 0 |
| Lowther Island, S. Pt. | 74 | 27 | 30 | 97 | 47 | 0 |
| Bathurst Island, | | | | | | |
| — Cape Cockburn | 75 | 3 | 0 | 100 | 25 | 0 |
| Byam Martin Island, | | | | | | |
| — Cape Gillman | 75 | 3 | 0 | 104 | 10 | 0 |
| Melville Island, | | | | | | |
| —Hecla and Griper B. Winter Har., obs. | 74 | 47 | 10 | 110 | 48 | 15 |
| *Var.* 127° 48′ *E.* | | | | | | |
| — Cape Dundas | 74 | 27 | 50 | 113 | 57 | 35 |
| — Liddon's Gulf, entrance, about | 75 | 2 | 0 | 113 | 0 | 0 |
| Cape Hurd | 77 | 42 | 0 | 78 | 47 | 0 |
| Cape Bullen | 74 | 22 | 0 | 84 | 45 | 0 |
| Cape Warrender | 74 | 27 | 0 | 81 | 40 | 0 |
| Cape Horsburgh | 74 | 55 | 0 | 78 | 40 | 0 |
| Cape Leopold | 75 | 40 | 0 | 78 | 5 | 0 |
| Cape Clarence | 76 | 45 | 0 | 77 | 40 | 0 |
| *Var.* 107° *W.* | | | | | | |

## LATITUDES AND LONGITUDES.

| (125) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Hackluyt's Islands | 77 | 26 | 0 | 73 | 40 | 0 |
| Carey's Islands | 76 | 49 | 0 | 73 | 10 | 0 |
| Cape Parry | 77 | 6 | 0 | 71 | 23 | 0 |
| Arabella Rock | 76 | 34 | 0 | 70 | 34 | 0 |
| Wolstenholme S. ent. | 76 | 29 | 0 | 70 | 0 | 0 |
| Dalrymple Rock | 76 | 28 | 0 | 70 | 42 | 0 |
| Wolstenholme Island | 76 | 24 | 0 | 70 | 22 | 0 |
| Cape Dudley Digges | 76 | 5 | 0 | 68 | 54 | 0 |
| Cape York | 75 | 55 | 0 | 66 | 38 | 0 |
| Bushnan's Island | 76 | 4 | 0 | 65 | 28 | 0 |
| Cape Melville | 76 | 3 | 0 | 64 | 30 | 0 |
| *Var.* 90° 18′ *W.* | | | | | | |
| Skene's Islands | 76 | 5 | 0 | 63 | 24 | 0 |
| Cape Walker | 75 | 46 | 0 | 59 | 54 | 0 |
| Sabine's Islands | 75 | 26 | 0 | 60 | 9 | 0 |
| Cape Seddon | 75 | 15 | 0 | 59 | 10 | 0 |
| Baffin's Islands | 74 | 37 | 0 | 57 | 35 | 0 |
| Devil's Thumb | 74 | 16 | 0 | 57 | 56 | 0 |
| Upernavik | 73 | 25 | 0 | 57 | 26 | 0 |
| Vrow or Woman's Is. | 72 | 45 | 0 | 56 | 40 | 0 |
| Black Hook | 71 | 27 | 0 | 55 | 31 | 0 |
| Four Islands, Point | 70 | 46 | 0 | 54 | 3 | 0 |
| Waygat or Hare I., | | | | | | |
| — N. E. side | 70 | 26 | 17 | 54 | 51 | 49 |
| Disco Island, N. end | 70 | 12 | 0 | 55 | 0 | 0 |
| — S. E. Road | 69 | 7 | 0 | 53 | 30 | 0 |
| — Lively Bay | 69 | 10 | 0 | 54 | 30 | 0 |
| Whale Islands, | | | | | | |
| — KronPrin'sFactory | 68 | 58 | 0 | 53 | 13 | 0 |
| *Var.* 70° 24′ *W.* | | | | | | |
| Cape Chidley | 68 | 37 | 0 | 53 | 33 | 0 |
| Savage Islands | 67 | 44 | 0 | 53 | 40 | 0 |
| Queen Ann's Cape | 66 | 26 | 0 | 53 | 20 | 0 |
| Victorious Rock | 66 | 21 | 0 | 53 | 47 | 0 |
| Coquin Sound | 65 | 38 | 0 | 53 | 0 | 0 |
| Mosquito Cove | 64 | 55 | 13 | 52 | 56 | 45 |
| Godt-haab | 64 | 9 | 55 | 51 | 50 | 0 |
| Lichtenfield | 62 | 59 | 0 | 51 | 18 | 0 |
| Cape Farewell | 59 | 45 | 0 | 47 | 50 | 0 |

Baffin's Bay. David's Strait.

### XXVII. The Coasts of EAST GREENLAND, ICELAND, and SPITZBERGEN, with the adjacent Islands.

| | | | | | | |
|---|---|---|---|---|---|---|
| Staten Hook | 59 | 38 | 0 | 44 | 30 | 0 |
| Cape Barclay | 69 | 13 | 0 | 24 | 25 | 0 |
| Scoresby's Sound, | | | | | | |
| — Cape Brewster | 70 | 11 | 0 | 22 | 0 | 0 |
| — Cape Tobin | 70 | 26 | 0 | 21 | 55 | 0 |
| — Cape Stewart | 70 | 28 | 0 | 22 | 36 | 0 |
| Rathbone I., E. end | 70 | 40 | 0 | 21 | 15 | 0 |
| Cape Gladstone | 71 | 33 | 0 | 21 | 38 | 0 |
| Smith's Island | 71 | 49 | 0 | 22 | 17 | 0 |
| Cape Moorsom | 72 | 11 | 0 | 21 | 51 | 0 |
| Cape Parry | 72 | 27 | 0 | 21 | 45 | 0 |
| Bontekoe I., E. end | 73 | 7 | 0 | 21 | 18 | 0 |
| Cape Freycinet | 72 | 45 | 0 | 22 | 30 | 0 |
| Cape Broer Ruys | 73 | 33 | 0 | 20 | 28 | 0 |
| Jackson's I., S.E. Pt. | 73 | 58 | 0 | 19 | 55 | 0 |
| GaelHamke'sBay,ent. | 74 | 5 | 0 | 20 | 0 | 0 |
| Cape Borlase Warren | 74 | 15 | 0 | 19 | 21 | 0 |

East Greenland.

| (126) Places. | Lat. N. | | | Lon. W. | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Pendulum Is., S. Pt. | 74 | 32 | 19 | 18 | 50 | 0 |
| — Cape Desbrowe | 74 | 40 | 0 | 18 | 20 | 0 |
| Shannon Island, | | | | | | |
| — Cape Philip Broke | 74 | 56 | 0 | 17 | 22 | 0 |
| — N. E. Point | 75 | 14 | 0 | 17 | 0 | 0 |
| Jan Mayen's Island, | | | | | | |
| — N. E. Point | 71 | 8 | 30 | 7 | 25 | 48 |
| — English Bay | 71 | 0 | 0 | 8 | 9 | 0 |
| — South Cape | 70 | 49 | 0 | 8 | 44 | 0 |
| — S. E. Cape | 7 | 1 | 30 | 7 | 29 | 0 |
| Portland Isle | 63 | 22 | 0 | 18 | 54 | 0 |
| Cape Hecla | 63 | 32 | 0 | 20 | 16 | 0 |
| Cape Reikianess | 63 | 55 | 0 | 22 | 47 | 45 |
| Reikiaviig, Road | 64 | 9 | 0 | 21 | 51 | 30 |
| Besseatæd | 64 | 6 | 9 | 21 | 53 | 34 |
| Lambhuus | 64 | 6 | 17 | 21 | 55 | 30 |
| Patrix Fiord | 65 | 35 | 45 | 24 | 9 | 53 |
| North Cape | 66 | 44 | 0 | 22 | 44 | 0 |
| Holum | 65 | 44 | 0 | 19 | 44 | 0 |
| Grim's Island | 66 | 57 | 0 | 19 | 12 | 0 |
| Langanes | 66 | 22 | 0 | 16 | 6 | 0 |
| Enkuysen Island | 64 | 54 | 0 | 10 | 28 | 0 |
| | | | | | East | |
| Little Table Island | 80 | 48 | 0 | 20 | 25 | 0 |
| Walden Island | 80 | 35 | 0 | 19 | 51 | 0 |
| *Var.* 17° 42′ *W.* | | | | | | |
| Black Point | 80 | 29 | 0 | 19 | 26 | 0 |
| Low Island, W. Pt. | 80 | 18 | 0 | 18 | 10 | 0 |
| Shoal Point | 80 | 12 | 0 | 17 | 52 | 0 |
| Verlegen Hook | 80 | 2 | 0 | 16 | 32 | 0 |
| Treurenburg Bay, | | | | | | |
| — Hecla Cove | 79 | 55 | 8 | 16 | 48 | 45 |
| *Var.* 18° 46′ *W.* | | | | | | |
| Cape Fanshawe | 79 | 37 | 30 | 18 | 17 | 0 |
| Mussell Bay | 79 | 52 | 0 | 15 | 42 | 0 |
| Grey Hook | 79 | 48 | 0 | 14 | 56 | 0 |
| Moffen Island, N. Pt. | 80 | 1 | 0 | 14 | 38 | 0 |
| Flat Hook | 79 | 50 | 30 | 11 | 56 | 0 |
| Fair Haven, entrance | 79 | 49 | 0 | 11 | 25 | 0 |
| Vogel Sang, N. end | 79 | 52 | 0 | 11 | 25 | 0 |
| Foul Point | 79 | 47 | 0 | 11 | 20 | 0 |
| Amsterdam Island, | | | | | | |
| — Hakluyt's Head | 79 | 47 | 0 | 10 | 54 | 0 |
| Smeirenburg | 79 | 42 | 30 | 11 | 7 | 0 |
| Dane's Island, S. Pt. | 79 | 37 | 0 | 10 | 52 | 0 |
| *Var.* 24° 30′ *W.* | | | | | | |
| Magdalena Bay, entr. | 79 | 33 | 0 | 10 | 45 | 0 |
| Hamburgher's Bay | 79 | 28 | 0 | 10 | 45 | 0 |
| Cross Bay, Mitre Cape | 79 | 10 | 0 | 11 | 26 | 0 |
| King's Bay, S.W. Cape | 78 | 50 | 0 | 11 | 33 | 0 |
| Charles' I., N. end | 78 | 53 | 0 | 10 | 32 | 0 |
| — Middle Hook | 78 | 36 | 0 | 10 | 50 | 0 |
| Ice Sound, entrance | 78 | 9 | 0 | 14 | 1 | 0 |
| Bell Sound, entrance | 77 | 35 | 0 | 14 | 57 | 0 |
| Horn Sound, entrance | 77 | 2 | 0 | 16 | 15 | 0 |
| Horn Mount | 76 | 58 | 0 | 16 | 35 | 0 |
| South Cape or | | | | | | |
| Point Lookout | 76 | 39 | 0 | 17 | 20 | 0 |
| Hope Island, N.E. Pt. | 76 | 33 | 0 | 22 | 7 | 0 |
| — S.W. Point | 76 | 20 | 0 | 20 | 40 | 0 |
| Bear or Cherie Island | 74 | 30 | 0 | 19 | 5 | 0 |

Iceland. Spitzbergen and adjacent Islands.

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## THE TIMES OF HIGH WATER,

On the Full and Change of the Moon, at the principal PORTS, and along the COASTS, particularly of GREAT BRITAIN and IRELAND, with the vertical Rise of the Tide in Feet at the Spring Tides.

| Places. | Situation. | Times. | | Rise |
|---|---|---|---|---|
| **A.** | | | | |
| | | h. | m. | Feet |
| Abbeville . . . | France . . | 10 | 30 | |
| Abb's (St.), Head | Scotland . . | 2 | 30 | |
| Aberdeen . . . | Scotland . . | 12 | 45 | 14 |
| Aberdovy . . . | Wales . . . | 7 | 30 | 13 |
| Aberistwith . . | Wales . . . | 7 | 30 | 13 |
| Achill Head . . | Ireland . . | 6 | 0 | |
| Achen . . . . | Sumatra . . | 9 | 0 | |
| Adventure Bay | Australia . . | 4 | 36 | |
| African Islands, | | | | |
| – South Island | Indian Ocean | 9 | 39 | 8 |
| Agnes (St.) . . | Scilly Islands | 4 | 46 | 17 |
| Air Point . . . | Isle of Man . | 10 | 30 | |
| Aix . . . . . | France . . | 3 | 0 | |
| Alban's (St.) Head | England . . | 7 | 30 | |
| Alban's (St.) . . | Jersey . . | 12 | 30 | |
| Aldbro' Knaps. . | England . . | 10 | 40 | 8 |
| Alderney Island . | Eng. Channel | 6 | 45 | 17 |
| Algoa Bay, | | | | |
| – Cape Recife . | Africa . . . | 3 | 20 | 6 |
| Algoada Point . | C. of Malabar | 11 | 15 | |
| Aline River . . | England . . | 2 | 45 | |
| Altona . . . . | Germany . . | 6 | 0 | |
| Amazon R., entr. | S. America . | 6 | 0 | |
| Ambleteuse . . | France . . | 11 | 0 | 19 |
| Ameland Island . | North Sea . | 10 | 30 | |
| Amelia Harbour . | United States | 9 | 0 | |
| Amirante Island . | Indian Ocean | 3 | 30 | 9 |
| Amlwick Port . . | Anglesea . . | 10 | 30 | 24 |
| Amsterdam, Bar . | Holland . . | 3 | 0 | 18 |
| Amsterdam Island | Pacific Ocean | 8 | 30 | |
| Andrew's(St.)Bay | Scotland . . | 2 | 15 | 15 |
| Andrews, (St.) . | Passamaquo- | | | |
| | dy Bay. . | 10 | 45 | 30 |
| Angar Sound . . | Gulf of Persia | 4 | 30 | 7 |
| Angers . . . . | France . . | 12 | 0 | |
| Angra Bay . . . | Terceira . . | 11 | 45 | 8 |
| Anholt Island . . | Cattegat . . | 12 | 0 | |
| Ann (Cape) . . | United States | 11 | 30 | 12 |
| Ann's (St.), Isle . | Seychelles . | 5 | 30 | 6 |
| Annamooka . . | Pacific Ocean | 6 | 0 | |
| Annapolis . . . | United States | 10 | 0 | 28 |
| Anticosta I., W.end | Gulf St. Law. | 3 | 30 | |
| Antonio, (Cape) . | Cuba . . . | 9 | 30 | 1½ |
| Antwerp . . . | Netherlands . | 6 | 0 | 14 |
| Arcasson, | | | | |
| Basin de) . . . | France . . | 3 | 45 | 16 |
| Archangel, Bar . | Russia . . | 6 | 0 | |
| Ardglass Pier . . | Ireland . . | 10 | 30 | 19 |
| Arklow . . . . | Ireland . . | 9 | 15 | |
| Arnheim Bay . . | Australia . . | 8 | 0 | 8 |
| Arran Island . . | Scotland . . | 11 | 15 | 9 |
| Arundel . . . . | England . . | 9 | 20 | 16 |
| Asaph, (St.) Bay | Australia . . | 5 | 45 | 14 |
| Atomeri Island . | Brazil . . . | 0 | 49 | |

| Places. | Situation. | Times. | | Rise |
|---|---|---|---|---|
| | | h. | m. | Rise |
| Augustine(St.)Bar | United States | 7 | 30 | 6 |
| Augustine(St.)Bay | Madagascar . | 4 | 30 | 13 |
| Auray . . . . | France . . | 5 | 45 | |
| Avranches . . . | France . . | 6 | 0 | |
| Awatscha Bay . . | Kamtschatka | 4 | 36 | |
| Ayamonte . . . | Spain . . . | 1 | 30 | |
| **B.** | | | | |
| Babelmandel Str. | Red Sea . . | 12 | 0 | |
| Babelmandel, I. . | Red Sea . . | 11 | 30 | 6 |
| Bahia . . . . | Brazil . . . | 4 | 15 | 7 |
| Balade Harbour . | N. Caledonia | 6 | 30 | |
| Balambouang Bay | Java . . . | 10 | 15 | |
| Balasore . . . | India . . . | 9 | 45 | 12 |
| Balbriggen . . . | Ireland . . | 10 | 40 | 11 |
| BallingskellingsB. | Ireland . . | 3 | 15 | |
| Bally I., Town . | East. Archip. | 12 | 30 | |
| Bally Castle . . | Ireland . . | 5 | 45 | |
| Bally Shannon . | Ireland . . | 6 | 45 | |
| Balta . . . . . | Shetland . . | 3 | 0 | 6 |
| Baltimore . . . | Ireland . . | 3 | 45 | 12 |
| Bamff . . . . | Scotland . . | 11 | 30 | |
| Bancoot River . . | India . . . | 11 | 0 | 11 |
| Banda Isles . . | Banda Sea . | 4 | 0 | |
| Bantry Bay . . | Ireland . . | 3 | 45 | 11 |
| Barbary Point . . | Africa . . . | 10 | 30 | |
| Barbe (St.) . . | China Sea . | 6 | 0 | |
| Bardsey Island . | Wales . . . | 8 | 15 | |
| Barfleur (Cape) . | France . . | 7 | 30 | |
| Barmouth . . . | Wales . . . | 7 | 55 | 13 |
| Barnstable Bar . | England . . | 5 | 30 | 26 |
| Barren Islands . | Madagascar . | 4 | 45 | 12 |
| Bas (Isle de) . . | Eng. Channel | 3 | 45 | 27 |
| Basseen River . | Persia . . | 12 | 30 | 17 |
| Bate Harbour . . | Gulf of Cutch | 12 | 0 | 14 |
| Baticolo Riv. ent. | Ceylon . . | 4 | 0 | 3 |
| Baudsey Cliff . . | England . . | 10 | 30 | |
| Bayonna . . . | Spain . . . | 4 | 45 | |
| Bayonne . . . | France . . | 3 | 30 | |
| BeachyHead,offing | England . . | 11 | 0 | 21 |
| Beachy Hd., on sh. | England . . | 9 | 45 | 20 |
| Bear Island . . | Hudson's Bay | 12 | 0 | |
| Beaver Harbour . | Bay of Fundy | 10 | 45 | 26 |
| Beaumaris . . . | Wales . . . | 10 | 15 | 24 |
| Bee's (St.) Head . | England . . | 11 | 0 | |
| Belfast . . . . | Ireland . . | 10 | 5 | |
| Belle Isle . . . | Bay of Biscay | 3 | 0 | |
| Bembridge Point . | Isle of Wight | 11 | 40 | |
| Bencoolen, | | | | |
| – Fort Marlbro' . | Sumatra . . | 0 | 0 | |
| Bergen . . . . | Norway . . | 1 | 30 | |
| Bermuda Isle, | | | | |
| – St.GeorgeTown | Atlant. Ocean | 7 | 49 | 6 |
| Berry Isles . . . | Lucayos . . | 7 | 30 | |
| Berwick . . . | England . . | 2 | 15 | 16 |

## TIMES OF HIGH WATER.

| Places. | Situation. | Times. | | Rise |
|---|---|---|---|---|
| | | h. | m. | Feet |
| Bic Island | R.St.Lawren. | 2 | 0 | |
| Bigbury Bay | England | 5 | 50 | 15 |
| Bilboa | Spain | 3 | 15 | 20 |
| Biscay | Spain | 4 | 30 | |
| Bissao | Africa | 6 | 30 | 14 |
| Blakeney | England | 6 | 50 | 17 |
| Blanco (Cape) | Africa | 9 | 45 | |
| Blaskets | Ireland | 3 | 45 | 8½ |
| Blaze (St.) Cape | Africa | 3 | 0 | |
| Block Island | United States | 7 | 37 | 5 |
| Blue Nose | White Sea | 5 | 30 | |
| Blythe | England | 2 | 45 | 12 |
| Bojador (Cape) | Africa | 0 | 0 | |
| Bolt Head | England | 5 | 55 | 20 |
| Bombay Castle | India | 11 | 10 | 17 |
| Bombay Offing | India | 12 | 0 | |
| Bombay Hook | United States | 10 | 30 | |
| Bominy Harbour | India | 2 | 30 | |
| Bonny River | Africa | 5 | 0 | 9 |
| Borkum Island | Holland | 11 | 30 | 15 |
| Boston | England | 7 | 15 | |
| Boston | United States | 11 | 25 | 12 |
| Botany Bay | New S. Wales | 8 | 0 | 7 |
| Boulogne | France | 10 | 30 | 19 |
| Bourdeaux | France | 3 | 0 | |
| Bowen Port | Australia | 10 | 0 | 9 |
| Boyanna Bay | Madagascar | 4 | 30 | 15 |
| Brassa Sound | Shetland | 10 | 0 | 9 |
| Bray Head | Ireland | 3 | 30 | |
| Bree Bank | North Sea | 3 | 30 | |
| Brehat Island | France | 7 | 30 | 36 |
| Bremen | Germany | 6 | 0 | |
| Brest Harb. | France | 3 | 48 | 19 |
| Brewershaven | Holland | 2 | 30 | 16 |
| Bride's (St.) Bay | Wales | 6 | 0 | |
| Bridgewater | England | 6 | 45 | 22 |
| Bridlington | England | 4 | 30 | 15 |
| Bridport | England | 6 | 45 | |
| Briel | Holland | 3 | 0 | 14 |
| Brighton | England | 10 | 6 | 16 |
| Bristol | England | 6 | 45 | 40 |
| Broach R. ent. | India | 4 | 15 | |
| Broad Haven | Ireland | 6 | 0 | |
| Broad Sound | Australia | 11 | 0 | 25 |
| Broken Bay | New S. Wales | 8 | 0 | 8 |
| Buchanness | Scotland | 12 | 0 | 13 |
| Bulama Island | Bijooga Is. | 4 | 30 | 15 |
| Buller (Cape) | Fernando Po. | 4 | 15 | 6 to 8 |
| Bulsaur R. entr. | India | 1 | 45 | 18 |
| Burlings | Portugal | 3 | 0 | |
| Burnt Island | Scotland | 2 | 30 | 14 |
| Burry Harbour | Wales | 6 | 0 | - |
| Busheer | Gulf of Persia | 7 | 30 | 6 |
| Bussora, Factory | Turkey in Asia | 6 | 0 | |
| Bustard Bay | New S. Wales | 8 | 0 | 8 |
| Button's Islands | Hudson's Bay | 6 | 50 | |
| Button Ness | Scotland | 2 | 0 | |
| Byron,(Cape,)Bay | Australia | 9 | 45 | 6 |
| C. | | | | |
| Cadiz, obs. | Spain | 2 | 30 | |
| Caen | France | 9 | 0 | 20 |
| Caernarvon, Bar | Wales | 9 | 0 | 22 |
| Cairston | Orkneys | 9 | 0 | 12 |
| Calabar,(New,)R. | Africa | 5 | 0 | 9 |
| Calais | France | 11 | 30 | 19 |
| Calcutta, Ft. Wm. | India | 3 | 5 | |
| Caldy Island | Wales | 6 | 0 | 34 |
| Caledonia, (New,) — South end | South Pacific | 8 | 15 | |
| Calf of Man | Isle of Man | 10 | 30 | |
| Camarren R. entr | Africa | 6 | 0 | 7 |
| Camiguen Isle | Babuyan Isles | 6 | 0 | |
| Campbell, (Cape) | New Zealand | 9 | 30 | |
| Campbell, (Port) | America | 9 | 0 | |
| Camperdown | Holland | 4 | 30 | |
| Cancale | France | 7 | 0 | |
| Canna Sound | Ireland | 5 | 15 | |
| Canso, (Cape) | America | 8 | 50 | 8 |
| Canso Harbour | America | 8 | 45 | 7 |
| Cantin, (Cape) | Africa | 10 | 0 | |
| Cantire, (Mull of) | Scotland | 9 | 0 | 5 |
| Cappel, (West) | Holland | 0 | 30 | |
| Capricorn, (Cape) | New Holland | 8 | 0 | 7 |
| Cardagos Garayos — North Island | Indian Ocean | 2 | 30 | 4 |
| Cardiff | Wales | 6 | 0 | |
| Cardigan Bar | Wales | 7 | 0 | 20 |
| Carlingford Bar | Ireland | 10 | 40 | 17 |
| Carlisle | England | 12 | 0 | |
| Carlos, (St.) Port | Chiloe Island | 11 | 45 | 19 |
| Carmarthen Bar | Wales | 6 | 30 | 24 |
| Carr Rocks | Scotland | 1 | 30 | |
| Carrick Island | Gulf of Persia | 9 | 0 | |
| Carrickfergus | Ireland | 10 | 30 | 8 |
| Cartagena | Colombia | 2 | 0 | 1 |
| Casco Bay | Coast of Maine | 10 | 45 | 9 |
| Caskets | Eng. Channel | 6 | 45 | 18½ |
| Castlehaven | Ireland | 4 | 0 | 12 |
| Catherine's(St.)Pt | Isle of Wight | 8 | 30 | |
| Catherine's (St.) I. | Brazil | 2 | 30 | 6 |
| Catness | White Sea | 5 | 15 | |
| Catwater | England | 5 | 30 | 18 |
| Cayenne | Guayana | 4 | 30 | 6 |
| Charante R. entr. | France | 4 | 0 | 20 |
| Charles, (Cape) | United States | 7 | 0 | 5 |
| Charles (Cape) | Labrador | 10 | 0 | |
| Charleston Bar | United States | 7 | 0 | 6 |
| Charlotte Town | P. Edward's I. | 10 | 30 | 6 |
| Charlotte's(Qu)Sd | New Zealand | 9 | 0 | |
| Chat, (Cape) | R St. Lawren. | 12 | 0 | 13 |
| Chatham | England | 1 | 0 | |
| Chedabucto Bay | Nova Scotia | 8 | 30 | 8 |
| Cheduba, Town | Aracan | 11 | 30 | |
| Chepstow | England | 7 | 30 | 70 |
| Cherbourg | France | 7 | 35 | 20 |
| Chester Bar | England | 10 | 30 | 26 |
| Chester | United States | 1 | 30 | |
| Chichester Harb. | England | 11 | 30 | 18 |
| Chignecto Bay, — Apple River | Bay of Fundy | 11 | 0 | 32 |
| Chittagong Bar | India | 1 | 0 | |
| Christmas Sound | Terradel Fueg | 2 | 30 | |
| Christmas Harb. | Kerguellan's | 10 | 0 | |

# TABLE LVII.

## TIMES OF HIGH WATER.

| Places. | Situation. | Times. | | Rise | Places. | Situation. | Times | | Rise |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Feet | | | | | Feet |
| Churbar Bay | Persia | 6 | 0 | 10 | Donegal Bar | Ireland | 10 | 0 | 12 |
| Churchill, (Cape) | Davis's Straits | 7 | 20 | | Dort | Holland | 3 | 0 | |
| Clarence Straits | Australia | 9 | 45 | 8 | Dovarnenez Road | France | 3 | 15 | 21 |
| Clear (Cape) | Ireland | 4 | 0 | 12 | Dover Pier | England | 11 | 16 | 20 |
| Clogher Head | Ireland | 10 | 30 | 10 | Douglas | Isle of Man | 10 | 30 | 21 |
| Coast, (Cape) | Africa | 3 | 30 | 7 | Downs | England | 11 | 15 | 18 |
| Cockspar | America | 9 | 0 | | Drogheda Bar | Ireland | 10 | 40 | 12 |
| Cod, (Cape) | United States | 11 | 30 | 6 | Drontheim | Norway | 2 | 15 | |
| Comoro Isle | Mozambique | 4 | 45 | 12 | Dublin Bar | Ireland | 10 | 30 | 12 |
| Condore, (Pulo) | China Sea | 4 | 16 | 7 | Dudgeon Lights | North Sea | 7 | 30 | |
| Conquet Road | France | 3 | 0 | 21 | Dunbagon Head | Ireland | 6 | 0 | |
| Conway | Wales | 10 | 15 | 24 | Dunbar | Scotland | 2 | 0 | |
| Cooley Point | Ireland | 10 | 40 | 12 | Duncansby Head | Scotland | 10 | 0 | 9 |
| Copeland Island | Ireland | 10 | 30 | | Dundalk Bar | Ireland | 10 | 45 | 17 |
| Coquet Island | England | 2 | 45 | 15 | Dundedy Head | Ireland | 4 | 0 | 11 |
| Coringa Bay | India | 9 | 45 | 5½ | Dundee | Scotland | 2 | 15 | |
| Corisco Island | Africa | 5 | 0 | 7 | Dundrum Harb. | Ireland | 10 | 30 | 17 |
| Cork, (Cove) | Ireland | 4 | 30 | 18 | Dungarvon | Ireland | 4 | 30 | |
| Cornwall, (Cape) | England | 4 | 25 | 22 | Dungeness | England | 10 | 50 | 24 |
| Cornwallis, (Fort) | P. of Wales' I. | 2 | 0 | 9 | Dunkirk | France | 11 | 40 | 19 |
| Cornwallis, (Port) | Andaman Is. | 4 | 30 | | Dunnose | Isle of Wight | 8 | 56 | |
| Corunna | Spain | 3 | 0 | | Dursey Island | Ireland | 3 | 30 | |
| Country Harbour | Nova Scotia | 8 | 40 | 8 | Dusky Bay | New Zealand | 10 | 57 | |
| Coutance | France | 6 | 0 | | | | | | |
| Cowes | Isle of Wight | 11 | 0 | 15 | E. | | | | |
| Cracatoa Island | Str. of Sunda | 7 | 0 | 4 | | | | | |
| Crane Island | R. St Lawren. | 5 | 15 | | Eagle Island | Seychelles | 3 | 30 | 9 |
| Cromartie | Scotland | 11 | 45 | 14 | Easter Island | Pacific Ocean | 2 | 0 | |
| Cromer | England | 7 | 0 | 14 | Eastern Brace | Bay of Bengal | 9 | 45 | |
| Crookhaven | Ireland | 3 | 30 | 12 | Eddystone | Eng. Channel | 5 | 15 | 18 |
| Croque Harbour | Newfoundlan. | 6 | 30 | 6½ | Elbe R, red buoy | North Sea | 12 | 0 | 12 |
| Cross Island | White Sea | 4 | 15 | | Elena, St. (Port) | Patagonia | 4 | 30 | 24 |
| Cuckold's Point | River Thames | 2 | 15 | 18 | Elie Harbour | Frith of Forth | 2 | 11 | 14 |
| Culpec | India | 1 | 45 | | Elizabeth Town Pt | United States | 8 | 54 | 6 |
| Cumberland Basin | Bay of Fundy | 12 | 0 | 60 | Elizabeth Isles | United States | 9 | 52 | 5 |
| Curieuse Isle | Seychelles | 5 | 10 | 7 | Ellis Cove | Anticosti I. | 2 | 0 | 6 |
| Cuxhaven | Germany | 1 | 0 | | Embden | Germany | 12 | 0 | |
| | | | | | Endeavour R. ent. | New S. Wales | 8 | 0 | |
| D. | | | | | English River | Delagoa Bay | 5 | 20 | 12 |
| | | | | | English Road | C. Verde Is. | 7 | 30 | 5 |
| Dalkey Sound | Ireland | 9 | 28 | 6 | Enkhuysen | Holland | 12 | 0 | |
| Dartmouth Harb. | England | 6 | 5 | 14 | Eoaa, East Pt. | Friendly Isles | 7 | 0 | |
| David's (St.) Head | Wales | 6 | 0 | | Etang Harbour | Bay of Fundy | 10 | 45 | 26 |
| Dauphin, (Fort) | Madagascar | 4 | 30 | 7 | Etaples | France | 10 | 35 | 19 |
| Deadman's Point | England | 5 | 30 | | Exmouth Bar | England | 6 | 25 | 14 |
| Deal, Castle | England | 11 | 15 | 19 | Exuma Bar | Bahamas | 6 | 35 | |
| Deamon Point | Riv. St. Law. | 12 | 0 | 12 | Eyder River, ent. | Germany | 12 | 0 | 11 |
| Dee, River | Scotland | 12 | 45 | 26 | Eyemouth Harb. | Scotland | 2 | 15 | 16 |
| Delagoa Bay | Africa | 4 | 40 | 13½ | | | | | |
| Delaware River | United States | 9 | 0 | | F. | | | | |
| Delgada Point | Azores | 12 | 30 | 7 | | | | | |
| Delgado, (Cape) | Africa | 4 | 30 | 9 | Fair Head | Ireland | 9 | 0 | |
| Delos Islands | Africa | 6 | 35 | 13 | Fair Isle | Orkney Is. | 10 | 0 | 4 |
| Demaun Bar | India | 1 | 30 | 17 | Falmouth | England | 5 | 30 | 18 |
| — Offing | | 2 | 45 | | False Bay | Africa | 3 | 30 | 4 |
| Demerary R. entr. | Guayana | 4 | 30 | 9 | Fayal Road | Azores | 11 | 30 | 4½ |
| Denbigh | Wales | 2 | 15 | | Fear, (Cape) | America | 9 | 45 | |
| Desert (Mount) Rk. | Coast of Maine | 11 | 0 | | Fecamp | France | 10 | 0 | 19 |
| Diamond Point | India | 2 | 15 | | Fernando Noronha | S. Atlantic | 4 | 0 | 6 |
| Dieppe | France | 10 | 25 | 19 | Ferro Isles | Canaries | 3 | 0 | |
| Digges, Cape | Hudson's Bay | 12 | 0 | | Ferrol | Spain | 3 | 45 | 15 |

## TIMES OF HIGH WATER.

| Places. | Situation. | Times. h. | Times. m | Rise Feet |
|---|---|---|---|---|
| Ferriters | Ireland | 3 | 30 | |
| Fifeness | Scotland | 4 | 30 | |
| Filey | England | 4 | 30 | |
| Finisterre, (Cape) | Spain | 3 | 0 | |
| Finmark | Lapland | 2 | 15 | |
| Fisgard Bay | Wales | 6 | 30 | |
| Flamborough Head | England | 4 | 30 | |
| Flatholm | Bristol Chan. | 6 | 28 | 36 |
| Flats, (Kentish) | England | 11 | 0 | |
| Flemish Banks | North Sea | 3 | 0 | |
| Florida (Cape) | United States | 7 | 30 | |
| Florida Keys | G. of Florida | 8 | 30 | 5 |
| Flushing | Netherlands | 1 | 0 | 15 |
| Fly, or Vlie Gatway | Holland | 6 | 45 | |
| Fly, or Vlie Road | Holland | 7 | 30 | |
| Folkstone | England | 10 | 45 | 20 |
| Foreland, (North) | England | 11 | 15 | 17 |
| Foreland, (South) | England | 11 | 6 | 15 |
| Formby Point | England | 10 | 25 | 26 |
| Fort George | Scotland | 12 | 0 | |
| Fort St. John | Newfoundlan. | 9 | 0 | |
| Foul Island | Shetland | 9 | 30 | |
| Foulness | England | 9 | 0 | 16 |
| Fourchu, (Cape) | Nova Scotia | 8 | 45 | 13 |
| Fowey | England | 5 | 30 | 16 |
| Fox Isles | United States | 10 | 45 | 9 |
| Foyn's Island | Ireland | 5 | 0 | 16 |
| Francisco, (St) Pt. | New Albion | 11 | 46 | |
| Frehel, (Cape) | France | 6 | 0 | 45 |
| Fulta | India | 1 | 15 | |
| Funchal | Madeira | 12 | 15 | 9 |
| Fundy, (Bay of) | America | | | 60 |
| **G.** | | | | |
| Gaboon River | Africa | 5 | 0 | 17 |
| Gallicia, (Coast of) | Spain | 3 | 0 | |
| Galloper | R. Thames | 12 | 45 | |
| Galloway, (Mullof) | Scotland | 11 | 15 | |
| Galway Bay | Ireland | 4 | 30 | |
| Gambia River, — Bathurst Town | Africa | 8 | 10 | 6 |
| Garrone River ent. | France | 3 | 45 | 16 |
| Gaspé Bay | G.St.Lawren. | 3 | 0 | |
| Gay Head | United States | 7 | 37 | 5 |
| Geer, (Cape) | Africa | 2 | 15 | 10 |
| George River | United States | 10 | 45 | 9 |
| George's Bay | Fernando Po. | 4 | 0 | 7 |
| George, (St.) | Bermuda | 7 | 0 | 5 |
| Georgetown, Bar | United States | 6 | 50 | 4 |
| Gibraltar | Spain | 0 | 0 | |
| Glasgow | Scotland | 11 | 49 | |
| Goa | India | 11 | 30 | |
| Goat Island | Fernando Po | 4 | 0 | 7 |
| Goeree Island | Africa | 7 | 48 | 4 |
| Good Hope (Cape) | Africa | 3 | 0 | |
| Good Hope, (town) | Africa | 2 | 20 | 5 |
| Goodwin, (back of) | Downs | 1 | 30 | |
| Gore | England | 11 | 15 | |
| Goree Gatway | North Sea | 1 | 35 | |
| Gouldsborough | United States | 11 | 0 | 12 |
| Gowans, (St.) Head | Wales | 5 | 30 | 36 |
| Granville | France | 6 | 45 | |
| Gravelines | France | 11 | 45 | 18 |
| Gravesend | River Thames | 1 | 30 | 16 |
| Green Island | R. St. Lawren. | 3 | 0 | 16 |
| Green Island | Newfoundlan. | 9 | 0 | |
| Green Island | Nova Scotia | 8 | 0 | 8 |
| Green Point | Cof Good Hope | 2 | 20 | 5 |
| Greenwich | R. Thames | 2 | 28 | |
| Grizness | France | 11 | 0 | |
| Groyne | Spain | 3 | 0 | |
| Guayaquil River | Peru | 7 | 0 | |
| Guernsey Bar | Eng. Channel | 6 | 0 | 30 |
| Gundavee Riv. ent. | India | 2 | 0 | 19 |
| Gunfleet | R. Thames | 12 | 0 | |
| **H.** | | | | |
| Hackluyts Head | Spitsbergen | 1 | 30 | |
| Haerlem | Holland | 9 | 0 | |
| Hague, La, (Cape) | France | 7 | 45 | 21 |
| Halifax | Nova Scotia | 8 | 0 | 8 |
| Hamburgh | Germany | 6 | 0 | |
| Hammerfest | Norway | 1 | 10 | 9 |
| Hammond's Knoll | North Sea | 7 | 40 | 9½ |
| Hamoaze | England | 5 | 30 | 18 |
| Hampton Read | United States | 10 | 30 | |
| Hangcliff | Shetlands | 9 | 30 | 7 |
| Harlem | Netherlands | 9 | 0 | |
| Hartland Point | England | 6 | 0 | |
| Hartlepool | England | 3 | 45 | |
| Harwich | England | 11 | 30 | 14 |
| Hasborough Gat | England | 8 | 0 | 9½ |
| Hastings | England | 10 | 36 | |
| Hatteras, (Cape) | United States | 9 | 0 | |
| Havre | France | 10 | 30 | 22 |
| Haytien, (Cape) | Hayti | 6 | 0 | 2½ |
| Helegoland | North Sea | 11 | 0 | 9 |
| Helena, (St) Bay | Africa | 2 | 30 | |
| Helena, (St.) — James Town | Atlant. Ocean | 1 | 30 | |
| Helena (St.) Point | Patagonia | 4 | 30 | |
| Helens, (St.) | England | 11 | 45 | 16 |
| Helvoetsluys | Holland | 2 | 0 | |
| Henlopen, (Cape) | United States | 9 | 0 | 5 |
| Henry, (Cape) | United States | 10 | 0 | 4½ |
| Hillsborough Inlet | United States | 7 | 30 | 5 |
| Hollands Hook | Holland | 3 | 0 | |
| Holms | Bristol Chan. | 6 | 40 | 30 |
| Holyhead Bay | Wales | 10 | 0 | 18 |
| Holy I., Harb. | England | 2 | 30 | 15 |
| Honfleur | France | 9 | 30 | 18 |
| Hoorn | North Sea | 12 | 0 | |
| Hoseley Bay | England | 11 | 0 | 11 |
| Howe, (Port) | Nova Scotia | 8 | 30 | |
| Howth, Harbour | Ireland | 10 | 15 | 13 |
| Hull | England | 6 | 0 | 22 |
| Humber R., ent. | England | 5 | 15 | 18 |
| Hung Road | England | 6 | 45 | 46 |
| Hurst Castle | England | 10 | 0 | |
| **I.** | | | | |
| Ice Cove | Hudson's Bay | 10 | 0 | |
| Ilfracombe | England | 5 | 30 | |

# TABLE LVII.

## TIMES OF HIGH WATER.

| Places. | Situation. | Times. h. | m. | Rise Feet |
|---|---|---|---|---|
| Ingellee | India | 11 | 0 | |
| Inhamban | Africa | 4 | 15 | 10 |
| Inverness, — Fort George | Scotland | 12 | 0 | 14 |
| Ipswich | England | 12 | 0 | |
| Ireland, (W. Coast) | Atlantic Ocean | 3 | 0 | |
| Ireland, (S. Coast) | Atlantic Ocean | 5 | 51 | |
| Isle de Bas | France | 3 | 17 | 27 |
| Isle de Dieu | France | 3 | 0 | |
| Isle of Man, (S. side) | St. George Ch. | 10 | 20 | |
| Ives, (St.) | England | 4 | 30 | 22 |
| **J.** | | | | |
| Jackson, (Port) | New S. Wales | 8 | 15 | 6 |
| Jago (St.) Isle — Port Praya | C. Verde Is. | 6 | 0 | 4 |
| Janeiro, (Rio) | Brazil | 2 | 45 | 4½ |
| Jask, (Cape) | Persia | 6 | 0 | 7 |
| Jedore Head | Nova Scotia | 8 | 20 | 9 |
| Jericacoara | Brazil | 11 | 30 | 12 |
| Jersey (St. Aubin) | Eng. Channel | 6 | 0 | 36 |
| Johanna | Comoro Isles | 3 | 0 | 8 |
| John's (St.) | Ireland | 10 | 30 | 19 |
| John's (St.) | Newfoundlan. | 7 | 50 | 5 |
| John's, (St.) Cape | Africa | 5 | 0 | 7 |
| John's, (St.) | New Brunsw. | 11 | 30 | 24 |
| Joombas Riv. ent. | Africa | 8 | 10 | 6 |
| Juan, (St.) | Porto Rico | 8 | 20 | 1½ |
| Juba, Town | Africa | 4 | 38 | 10 |
| Julian, (St.) Port | Patagonia | 4 | 45 | |
| Jumbasseer Road | India | 4 | 45 | 36 |
| Junkseylon | India | 10 | 0 | 12 |
| Jutland (Coast) | Denmark | 12 | 0 | |
| **K.** | | | | |
| Karakakoa Bay | Owyhee | 3 | 49 | |
| Kedgeree | India | 11 | 30 | |
| Kenmare River | Ireland | 3 | 30 | 12 |
| Kennebeck | United States | 10 | 45 | 9 |
| Kentish Knock | Riv. Thames | 11 | 30 | 16 |
| Keppel Bay | New S. Wales | 9 | 30 | 14 |
| Kilduin Island | Lapland | 7 | 0 | 12 |
| Killibegs | Ireland | 6 | 45 | |
| Killough Pier | Ireland | 10 | 45 | 17 |
| King's Channel | Riv. Thames | 12 | 0 | 16 |
| King's Island | Bass's Strait | 3 | 30 | 12 |
| King's Road | Bristol Chan. | 6 | 45 | 46 |
| Kingstown Harb. | Ireland | 10 | 17 | 13 |
| Kinnaird's Head | Scotland | 12 | 0 | |
| Kinsale | Ireland | 4 | 30 | 15 |
| Kirkudbright | Scotland | 11 | 15 | |
| Kish Bank, Light | St George Ch. | 10 | 30 | 10 |
| Kishma I., S.W. Pt. | Gulf of Persia | 11 | 0 | 12 |
| Kykduyn | Holland | 7 | 30 | 12 |
| **L.** | | | | |
| Lagos Bay | Portugal | 2 | 0 | 13 |
| Lagos | Africa | 4 | 0 | 6 |
| Lambaness | Shetlands | 9 | 30 | 5 |
| Lancaster | England | 11 | 15 | |
| Land's End | England | 4 | 30 | |
| Lee Stone | Ireland | 10 | 30 | 14 |
| Leith Pier | Scotland | 2 | 20 | 16½ |
| Le Have, (Cape) | Nova Scotia | 8 | 0 | 7 |
| Leman & Ower | North Sea | 7 | 0 | |
| Lerwick | Shetland | 9 | 45 | 10 |
| Leven, (Port) | Arabia | 3 | 30 | 7½ |
| Lewis Islands | Scotland | 6 | 0 | 11 |
| Lewis, (Butt of) | Scotlands | 6 | 45 | |
| Limerick | Ireland | 6 | 0 | 16 |
| Lindy River | Africa | 4 | 15 | 12 |
| Lintin Island | China | 12 | 0 | |
| Lipcomb Harb. | Nova Scotia | | | |
| Lisbon | Portugal | 4 | 0 | |
| Little Hampton, (entr. to) | England | 11 | 30 | 14 |
| Liverpool | England | 11 | 0 | 27 |
| Liverpool, Harb. | Nova Scotia | 7 | 50 | 8 |
| Lizard Point | England | 4 | 55 | 18 |
| — Off Shore | | 7 | 55 | |
| Loando | Africa | 4 | 30 | 6 |
| Loch Swilly | Ireland | 7 | 30 | |
| Loire River, entr | France | 3 | 45 | 19 |
| London Bridge | England | 2 | 7 | 18½ |
| London, (New) | United States | 8 | 54 | 6 |
| Londonderry | Ireland | 6 | 0 | |
| Long Island | United States | 3 | 0 | |
| Long Sand Head | Riv. Thames | 11 | 30 | 15 |
| Longships | England | 4 | 30 | 20 |
| Lookout, (Cape) | United States | 10 | 30 | 7 |
| Loop Head | Ireland | 4 | 30 | |
| L'Orient, (Port) | France | 3 | 30 | 20 |
| Louis, (Port) | Mauritius | 12 | 30 | 3 |
| Louis, (Port) | France | 4 | 0 | 19 |
| Louisbourg | Breton Island | 7 | 15 | 5½ |
| Lowestoff, in shore | England | 10 | 38 | 7½ |
| — Roads | | 8 | 55 | 8½ |
| Luis, (St.) Harb. | Maranham | 7 | 0 | 18 |
| Lundy Island | Bristol Chan. | 5 | 30 | 30 |
| Luza River, entr. | Madagascar | 4 | 30 | 15 |
| Lyme Regis | England | 6 | 30 | 13 |
| Lymington | England | 11 | 15 | |
| Lynn Deeps | England | 6 | 0 | 23 |
| **M.** | | | | |
| Machias | United States | 11 | 0 | 12 |
| Macoa | China | 9 | 52 | 10 |
| Madame Isle | Arabia | 4 | 0 | 5 |
| Madame Island | Breton Island | 8 | 0 | 8 |
| Madeira | Atlant. Ocean | 12 | 4 | 7 |
| Maes River, entr | Holland | 3 | 0 | |
| Mahé Island | Seychelles | 5 | 20 | 6½ |
| Mahone Bay | Nova Scotia | 8 | 0 | 8 |
| Majambo Bay | Madagascar | 4 | 30 | 16 |
| Makumba Island | Madagascar | 4 | 45 | 17 |
| Malacca Roads | India | 10 | 30 | |
| Malaga | Spain | 12 | 0 | 3 |
| Malaguash Bay | Nova Scotia | 8 | 0 | 8 |
| Malbay | Ireland | 4 | 0 | |
| Malo, (St.) | France | 6 | 0 | 45 |

## TIMES OF HIGH WATER.

| Places. | Situation. | Times. | | Rise |
|---|---|---|---|---|
| | | h. | m. | Feet |
| Manan, (Grand) | Bay of Fundy | 10 | 0 | 25 |
| Manicougan Bay | R. St. Lawren. | 1 | 0 | 12 |
| Manilla Bay | Phillipines | 10 | 40 | 2½ |
| Man of War Kay | Bahamas | 8 | 10 | 4 |
| Marble Head | United States | 11 | 30 | 12 |
| Marcou, (St.) Isles | France | 9 | 15 | 21 |
| Margaret's Bay | Nova Scotia | 8 | 0 | 7 |
| Margate Pier | England | 11 | 15 | 16 |
| Martin Vas Rocks | Atlant. Ocean | 3 | 45 | |
| Mary's (St.) Cape | Nova Scotia | 9 | 30 | 16 |
| Mary's (St.) Bar | United States | 8 | 15 | 7 |
| Mary's (St.) | Scilly Islands | 4 | 40 | 18 |
| Matane | R. St. Lawren. | 12 | 15 | |
| Mathieu, (St.) | France | 3 | 0 | 21 |
| May Island | Scotland | 1 | 30 | |
| May, (Cape) | United States | 8 | 30 | 6 |
| Mazeira Isle | Arabia | 10 | 48 | |
| Mellacoree River | Africa | 7 | 40 | 11 |
| Melo, (Port) | S. America | 4 | 15 | 15 |
| Mergui | India | 11 | 30 | 15 |
| Metway, (Port) | Nova Scotia | 7 | 50 | 8 |
| Milford Haven | England | 5 | 45 | 36 |
| Mille Vaches Point | R. St. Lawren. | 2 | 0 | |
| Minehead | England | 6 | 0 | 36 |
| Mines Chan., entr. | Bay of Fundy | 11 | 0 | 41 |
| Mingan Harbour | G. St. Lawren. | 3 | 0 | 11 |
| Minow Island | Madagascar | 5 | 0 | 15 |
| Miraporvas | West Indies | 9 | 30 | 2 |
| Mizen Head | Ireland | 3 | 0 | |
| Mocha | Arabia | 11 | 20 | 4 |
| Mogador | Africa | 4 | 0 | 10 |
| Mombas Island | Africa | 4 | 0 | 11 |
| Mongallon River | Africa | 3 | 45 | |
| Monterry | New Albion | 7 | 30 | |
| Montrose | Scotland | 1 | 30 | 13 |
| Moose Island | United States | 10 | 45 | 25 |
| Morebat, (Cape) | Arabia | 9 | 0 | |
| Moreton Bay | Australia | 9 | 45 | 8 |
| Morlaix | France | 5 | 15 | 30 |
| Morocco Coast | Africa | 2 | 15 | |
| Mossel Bay | Africa | 3 | 15 | 6 |
| Mount's Bay | England | 4 | 40 | 20 |
| Mount St. Michael | France | 6 | 30 | 54 |
| Mount Desert | United States | 11 | 0 | 12 |
| Mouton, (Port) | Nova Scotia | 8 | 0 | 7 |
| Mozambique, — St. George's I. | Africa | 4 | 15 | 12 |
| Mull of Cantire | Scotland | 10 | 30 | 5 |
| Mull of Galloway | Scotland | 11 | 15 | |
| **N.** | | | | |
| Nangasaki | Japan | 7 | 53 | |
| Nantes | France | 4 | 0 | |
| Nantes, Riv., entr. | France | 3 | 0 | |
| Nantucket Shoals | United States | 10 | 45 | |
| Nantucket, Harb. | United States | 12 | 3 | 6 |
| Nareenda Bay | Madagascar | 5 | 45 | |
| Nassau | New Provid. | 8 | 30 | 4 |
| Nassau Bar | United States | 7 | 30 | 7 |
| Natal River | Africa | 10 | 0 | 12 |
| Naze | Norway | 11 | 15 | |

| Places. | Situation. | Times | | Ris |
|---|---|---|---|---|
| | | h. | m | Fee |
| Needles | Isle of Wight | 8 | 56 | 9 |
| Negro, (Cape) Hr. | Nova Scotia | 8 | 0 | 7 |
| New Anchorage | New Prov. I. | 8 | 30 | 4 |
| Newburgh | Scotland | 12 | 30 | 13 |
| New Calabar, Riv. | Africa | 5 | 0 | 9 |
| New Bedford | United States | 7 | 37 | 5 |
| Newbury Port | United States | 11 | 15 | 10 |
| Newcastle | England | 4 | 0 | |
| Newcastle | United States | 12 | 0 | |
| Newhaven | England | 11 | 0 | 20 |
| Newhaven, Offing | United States | 9 | 0 | 8 |
| New London | United States | 8 | 54 | 5 |
| Newport | Wales | 6 | 45 | 24 |
| Newry | Ireland | 12 | 0 | |
| New York, — East River | United States | 8 | 54 | 7 |
| Nicholas, (St.) — Freshwater Bay | C. Verde Is. | 7 | 0 | 6 |
| Nicholas, (St.) Hr | R. St. Lawren | 12 | 0 | 12 |
| Nieuport | France | 11 | 15 | 17 |
| Noncowry, Harb. | Nicobars | 9 | 15 | 9 |
| Nootka Sound | America | 0 | 20 | 9 |
| Nore Light | River Thames | 12 | 30 | 14 |
| Norfolk Island, — Sidney Bay | Pacific Ocean | 7 | 45 | 7 |
| North Berwick | Scotland | 1 | 30 | |
| North (Cape) | Lapland | 3 | 44 | |
| Noss Head | Scotland | 9 | 15 | |
| **O.** | | | | |
| Obitahoo Isle, — Resolution Bay | Marquesas | 2 | 30 | |
| Oleron Island | France | 3 | 45 | 19 |
| Olonne Shoals | France | 3 | 30 | |
| Onega | White Sea | 7 | 30 | 6 |
| Oporto | Portugal | 3 | 15 | |
| Orfordness | England | 10 | 40 | 11 |
| Orkney Islands | North Sea | 10 | 30 | 8 |
| Ormes Head | Wales | 10 | 30 | |
| Ortegal, (Cape) | Spain | 3 | 0 | |
| Ostend | France | 12 | 0 | 16 |
| Otaheite Island, — Venus Point | Pacific Ocean | 10 | 30 | |
| Ouro River | Africa | 12 | 0 | 9 |
| Owers | British Chan. | 11 | 0 | 15 |
| Owharre Bay | Huahine | 11 | 50 | |
| Owls Head | Nova Scotia | 8 | 30 | 7 |
| **P.** | | | | |
| Padstow | England | 5 | 0 | 24 |
| Palma | Canaries | 3 | 0 | |
| Palmiras, Point | India | 8 | 30 | |
| Palos | Spain | 12 | 40 | |
| Panama | S. America | 3 | 0 | |
| Para | Brazil | 12 | 0 | 4 |
| Parcelar, Point | Malacca Str. | 5 | 40 | 14 |
| Parkgate | Wales | 10 | 30 | |
| Passage du Four | France | 4 | 0 | 19 |
| Passamaquoddy R — North Bay | Bay of Fundy | 10 | 45 | 30 |

## TIMES OF HIGH WATER.

| Places. | Situation. | Times. h. | Times. m | Rise Feet |
|---|---|---|---|---|
| Passandava Bay | Madagascar | 5 | 0 | 15 |
| Passier River entr | Borneo | 5 | 6 | 8 |
| Patta | Africa | 4 | 0 | 4½ |
| Paul de Leon, (St.) | France | 4 | 0 | |
| Paul's, (St.) Island | Indian Ocean | 11 | 0 | 3 |
| PauldeLoando, (St. | Africa | 4 | 30 | 6 |
| Pelican Harbour | Bahamas | 7 | 30 | 4 |
| Pembroke (Cape) | Hudson's Str. | 12 | 0 | |
| Penmarks | France | 3 | 30 | |
| Penobscot River | United States | 10 | 45 | 9 |
| Pentland Frith | Scotland | 10 | 30 | 8 |
| Penzance | England | 4 | 30 | 19 |
| Pernambuco | Brazil | 7 | 15 | 6 |
| Peter Head | Scotland | 12 | 0 | |
| Peveral Point | England | 9 | 0 | |
| Philadelphia | United States | 3 | 0 | |
| Philip, (Port) | New S. Wales | 2 | 30 | 6 |
| Pickersgill, Harb. | New Zealand | 10 | 57 | |
| Pictou Harbour | G. St. Lawren. | 7 | 0 | 6 |
| Pierre (St.) | Newfoundlan. | 9 | 0 | 7 |
| Piliers | R. St. Lawren. | 4 | 45 | |
| Pistolet Bay | Newfoundlan. | 6 | 45 | 5 |
| Placentia Harbour | Newfoundlan | 9 | 15 | 8 |
| Plettenberg Bay | Africa | 3 | 10 | 6 |
| Plymouth Dk. yd. | England | 5 | 30 | 18 |
| Plymouth | United States | 11 | 30 | 6 |
| Pomona | Orkneys | 3 | 0 | |
| Poole | England | 9 | 0 | 7 |
| Porsal | France | 5 | 0 | 20 |
| Portandik | Africa | 7 | 30 | 11½ |
| Port Bowen | P. Regent's Inlet | 11 | 12 | 6½ |
| Port Glasgow | Scotland | 11 | 45 | |
| Port Hood | Breton Island | 9 | 0 | 6 |
| Port Howe | Nova Scotia | 8 | 30 | 8 |
| Port Hunter | New S. Wales | 9 | 45 | 6 |
| Port Jackson | Nova Scotia | 8 | 0 | 7½ |
| Portland Bill | England | 7 | 15 | 8 |
| Portland Race | England | 9 | 15 | 7 |
| Portland Road | England | 6 | 15 | 7 |
| Portland | United States | 10 | 45 | 9 |
| Port Louis | France | 4 | 30 | 15 |
| Port Porto | France | 3 | 0 | |
| Port Praya | C. Verde Is. | 6 | 0 | 4 |
| Porto Santo | Madeira Isles | 12 | 30 | 9 |
| Port Royal | United States | 8 | 15 | 6 |
| Port Royal | Jamaica | | | 9in. |
| Port Rush | Ireland | 5 | 45 | 6 |
| Port Seaton | Scotland | 2 | 0 | |
| Port Stephens | New S. Wales | 9 | 15 | 8 |
| Portsmouth, Dk. yd | England | 11 | 40 | 16 |
| Portsmouth | United States | 11 | 15 | 10 |
| Port Spain | Trinidad | 6 | 30 | 5 |
| Portugal, — (Coast of) | Europe | 3 | 45 | |
| Praule Point | England | 5 | 55 | |
| Preston Pans | Scotland | 2 | 0 | |
| Prince's Island | Coast of Africa | 3 | 45 | 4½ |
| Providence Island | Lucayos | 7 | 30 | |
| Providence Island | Indian Ocean | 4 | 0 | 8 |
| Pudyona | N. Caledonia | 6 | 30 | |
| Puerto de Naos | Lanzarote I. | 11 | 45 | |
| Puerto de Plata | Hayti | 7 | 30 | 3 |
| Pulo Pinang | P. of Wales I. | 2 | 0 | 9 |
| Purfleet | Riv. Thames | 1 | 40 | 17 |
| **Q.** | | | | |
| Quebec | Canada | 6 | 45 | 20 |
| Queda Road | India | 10 | 0 | 6 |
| Queenborough | England | 1 | 15 | |
| Queen Charlotte's Sound | New Zealand | 9 | 0 | |
| Querimba Islands | Africa | 4 | 30 | 9 |
| Quiloa Harbour | Africa | 3 | 45 | |
| **R.** | | | | |
| Race Point | United States | 10 | 45 | |
| Rachlin Island | Ireland | 9 | 0 | |
| Racket, (Pulo) | Java | 9 | 0 | |
| Radama, (Port) | Madagascar | 4 | 40 | 13 |
| Rajapour | India | 11 | 0 | 12 |
| Rame Head | England | 5 | 45 | |
| Ramkins | Holland | 1 | 30 | |
| Ramsey | Isle of Man | 10 | 30 | |
| Ramsgate | England | 11 | 20 | 21 |
| Rangoon, — Bar | India | 3 | 0 | |
| Ray, (Cape) | Newfoundlan. | 9 | 0 | 8 |
| Reedy Island | United States | 11 | 15 | |
| Resolution Bay | Marquesas | 2 | 30 | |
| Resolution (Cape) | Hudson's Str. | 7 | 0 | |
| Rhe Island | France | 3 | 0 | |
| Rhode I., Harb. | United States | 7 | 37 | 5 |
| Rio Janeiro | Brazil | 2 | 40 | 4 |
| Robin Hood's Bay | England | 3 | 45 | |
| Roccas | S. Atlantic | 4 | 0 | 6 |
| Rochefort | France | 4 | 15 | 21 |
| Rochelle | France | 3 | 45 | |
| Rochester | England | 1 | 0 | |
| Rodrigues Island | Indian Ocean | 12 | 30 | 6 |
| Roman, (Cape) | United States | 10 | 30 | |
| Ronaldsha (North) | Orkney Is. | 9 | 45 | |
| Roseness | Orkney Is. | 10 | 30 | |
| Roseway (Port) | Nova Scotia | 8 | 15 | |
| Rotterdam | Holland | 3 | 0 | 7 |
| Rouen | France | 1 | 15 | |
| Royal Island Hr. | Bahamas | 7 | 45 | 3½ |
| Roymongril R., en. | India | 11 | 30 | |
| Ryde | England | 11 | 30 | |
| Rye Harbour | England | 10 | 40 | 24 |
| **S.** | | | | |
| Sable, (Cape) | Nova Scotia | 7 | 45 | 12 |
| Sable I., (S. Side) | N. Atlantic | 8 | 30 | 8 |
| — (North Side) | | 10 | 30 | 7 |
| Saintes | Carribbees | 6 | 45 | |
| Salangor Roads | India | 5 | 0 | |
| Salcombe | England | 5 | 55 | 20 |
| Saldanha Bay | Africa | 2 | 0 | 7 |
| Salem | United States | 11 | 30 | 12 |
| Salisbury Island | Hudson's Bay | 11 | 0 | |

## TIMES OF HIGH WATER.

| Places. | Situation. | Times. h. | m | Rise Feet |
|---|---|---|---|---|
| Salomon Isles | Chagos Arch. | 1 | 0 | 6 |
| Saltees | Ireland | 5 | 40 | 12 |
| Salt Island, — Mordeira Bay | C. Verde Is. | 7 | 45 | 5 |
| Salvadore,(St.) ent | Brazil | 4 | 15 | 7 |
| Salvador (St.) | Lucayos | 3 | 50 | |
| Sambro Harbour | Nova Scotia | 8 | 15 | 7 |
| Sandwich | England | 11 | 0 | |
| Sandwich Bay | Nova Scotia | 9 | 0 | 8 |
| Sandwich Bay | Labrador | 7 | 30 | 7 |
| Sandy Hook | New York | 7 | 30 | 6 |
| Sandy Isle | Madagascar | 2 | 15 | |
| San Lucar | Spain | 1 | 45 | |
| Santa Cruz | S. America | 8 | 40 | 32 |
| Savannah, entr. | United States | 11 | 15 | |
| Scarborough | England | 4 | 30 | 13 |
| Scarcies Rivers | Africa | 7 | 10 | 10 |
| Scattery Island | Ireland | 4 | 0 | 12 |
| Scaw | Denmark | 12 | 0 | 15 |
| Scilly Islands | British Chan. | 4 | 40 | 18 |
| Scolt Head | England | 6 | 20 | |
| Seaford | England | 10 | 15 | 20 |
| Seal Islands | Bay of Fundy | 8 | 45 | 12 |
| Searbett Isle | Guzarat | 1 | 30 | 10 |
| Seaton Sluice | England | 2 | 45 | 10 |
| Sebastian,(St.)Isle | Brazil | 2 | 30 | |
| Seine River, entr. | France | 10 | 30 | 25 |
| Selsea Bill | England | 9 | 36 | 16 |
| Selsea Harbour | England | 11 | 15 | 15 |
| Senegal, Bar | Africa | 10 | 30 | |
| Serangi Isles | Mindanao | 7 | 0 | |
| Setubal | Spain | 4 | 30 | |
| Seven Is. Harbour | R. St.Lawren. | 1 | 30 | 18 |
| Seven Is. Harbour | Bay of Fundy | 11 | 0 | 31 |
| Shag Harbour | Nova Scotia | 9 | 0 | 11 |
| Shannon R., entr. | Ireland | 3 | 45 | 12 |
| Sheepscut | United States | 10 | 45 | 9 |
| Sheet Harb. entr. | Nova Scotia | 8 | 30 | 7 |
| Shelburne Harb. | Nova Scotia | 8 | 0 | 8 |
| Sheerness Dk. yd. | England | 12 | 0 | 15 |
| Shepody Bay | Bay of Fundy | 11 | 30 | 48 |
| Sherbro River | Africa | 8 | 0 | 8 |
| Shetlands, S. end | North Sea | 10 | 30 | 6 |
| Shields | England | 3 | 0 | 13 |
| Shillocks | Ireland | 3 | 0 | |
| Ship Harbour | Gut of Canso | 8 | 0 | 8½ |
| Shipwash | River Thames | 12 | 0 | |
| Shoal Water Bay | Australia | 10 | 30 | 18 |
| Shoreham | England | 11 | 15 | 14 |
| Sidney Cove | Port Jackson | 8 | 15 | 7 |
| Sidney Harbour | Breton Island | 9 | 0 | 6 |
| SierraLeon,(Cape) | Africa | 7 | 30 | 11½ |
| Simons Bay | CofGoodHope | 3 | 30 | 3 |
| Simon's, (St.) Sd. | United States | 9 | 0 | 6 |
| Simon's, (St.) Bar | United States | 7 | 30 | 6 |
| Simons,(St.)Offing | United States | 6 | 45 | |
| Skerries | Wales | 9 | 45 | |
| Skerries | Ireland | 4 | 45 | 11 |
| Sky Island | Scotland | 6 | 0 | |
| Sligo Bay | Ireland | 6 | 45 | |
| Slyne | Ireland | 5 | 15 | |
| Smalls | Wales | 5 | 50 | |
| Smerwick Bay | Ireland | 3 | 30 | |
| Smiths Knoll | North Sea | 12 | 0 | |
| Sofala | Africa | 4 | 0 | 22 |
| Solebay | England | 10 | 30 | 7 |
| Sombrero Kay | Florida Kays | 8 | 0 | 5 |
| Somme R. entr. | France | 10 | 30 | |
| Southampton | England | 11 | 40 | 18 |
| South Light | Ireland | 10 | 15 | 12 |
| Southwold | England | 10 | 0 | 8 |
| Soutland Pass | Holland | 12 | 15 | 18 |
| Spain, (North Coast of) | Bay of Biscay | 3 | 0 | 16 |
| Spartel, (Cape) | Africa | 3 | 0 | |
| Spithead | England | 9 | 30 | |
| Split, (Cape) | Bay of Fundy | 11 | 15 | 40 |
| Spry Harbour | Nova Scotia | 8 | 30 | 7½ |
| Spurn Point | England | 5 | 20 | 23 |
| Stadtland | Norway | 12 | 0 | |
| Staples | Scotland | 2 | 30 | 15 |
| Start Point | England | 5 | 55 | 20 |
| Staxigo | Scotland | 9 | 15 | |
| Stockton | England | 4 | 30 | |
| Stonehaven | Scotland | 1 | 0 | |
| Strangford Bar | Ireland | 10 | 30 | 15 |
| — Town | Ireland | 11 | 45 | 15 |
| Stromness, Harb. | Orkneys | 10 | 30 | |
| Studwall's Road | Wales | 8 | 0 | |
| Suez, Harbour | Red Sea | 11 | 30 | 7 |
| Sunbury | United States | 9 | 30 | |
| Sunderland | England | 3 | 0 | 12 |
| Surat, Road | India | 4 | 0 | |
| Surinam, — Bram's Point | Guayana | 5 | 30 | |
| Swansea Bay | Wales | 5 | 56 | 30 |
| Sweetnose | Lapland | 8 | 30 | 16 |
| Swilly, (Loch) | Ireland | 6 | 30 | |
| Swin | Riv. Thames | 12 | 0 | 16 |

### T.

| Places. | Situation. | Times. h. | m | Rise Feet |
|---|---|---|---|---|
| Table Bay | C. Good Hope | 2 | 25 | 5 |
| Tagioca Point | Maranham | 9 | 30 | 6 |
| Tamatave Point | Madagascar | 4 | 18 | 8 |
| Tanna Island, — PortResolution | NewHebrides | 3 | 0 | |
| Tantang | Arabia | 4 | 30 | 6 |
| Tappanooly Bay | Sumatra | 6 | 0 | |
| Tarifa Island | Spain | 12 | 0 | 8 |
| Tarpaulin Cove | United States | 9 | 52 | 5 |
| Tavay Point | Bengal Bay | 10 | 0 | |
| Tay River, Bar | Scotland | 1 | 45 | |
| Tees River, entr. | England | 3 | 30 | 16 |
| Telling, (Cape) | Ireland | 6 | 0 | |
| Terceira, — Angra Bay | Azores | 11 | 45 | 6 |
| Terneuse | Netherlands | 2 | 15 | |
| Tervere | Holland | 1 | 30 | 16 |
| Texel, (entr. to) | Holland | 6 | 45 | |
| Texel Road | Holland | 7 | 45 | 6 |
| ThamesR (mouth) | England | 12 | 0 | |
| Thirsty Sound | New S. Wales | 10 | 45 | |
| Thomas, (St.) I. | Coast of Africa | 3 | 25 | 4½ |

## TIMES OF HIGH WATER.

| Places. | Situation. | Times h. | Times m. | Rise Feet |
|---|---|---|---|---|
| Tod Head | Scotland | 12 | 30 | |
| Tongataboo Island | Friendly Isles | 6 | 50 | |
| Topsham | England | 7 | 5 | 10 |
| Torbay | England | 6 | 0 | 20 |
| Tor Harbour | Red Sea | 10 | 30 | 5 |
| Tory Island | Ireland | 6 | 0 | |
| Townsend | United States | 10 | 45 | 9 |
| Trallee Bay | Ireland | 3 | 45 | |
| Traverse | R. St. Lawren. | 4 | 15 | 18 |
| Treguier | France | 5 | 30 | 32 |
| Trincomale | Ceylon Island | 6 | 0 | 3 |
| Tudwal's, (St.) Rd | Wales | 8 | 0 | 20 |
| Turtle Islands | Africa | 6 | 0 | 11 |
| Tuskar Rock | Ireland | 6 | 30 | |
| Two and a half Fathoms Bank | Malacca Str. | 5 | 20 | 14 |
| Tynemouth, entr. | England | 2 | 50 | 13 |
| Typa Roads | River Canton | 10 | 0 | 7 |
| **U.** | | | | |
| Ulietea Island | Society Isles | 11 | 30 | |
| Useand Villaine R | France | 3 | 0 | |
| Ushant I., withm | France | 3 | 45 | 20 |
| Ushant I., outside in the Offing | | 4 | 30 | |
| **V.** | | | | |
| Valdivia | Chili | 11 | 30 | 6 |
| Valentia Harbour | Ireland | 3 | 30 | |
| Vallery, (St.) en Caux | France | 10 | 15 | 19 |
| Vallery, (St.) sur Somme | France | 10 | 30 | 19 |
| Vandieman's Cape | New S. Wales | 7 | 15 | |
| Vannes | France | 3 | 45 | |
| Venus Point | Otaheite | 10 | 30 | |
| Verde, (Cape) | Africa | 7 | 45 | 3 |
| Versavah (Fort) | India | 12 | 15 | 16 |
| Vincent St (Cape) | Spain | 2 | 15 | |
| Vincent, (St.) Port | N. Caledonia | 8 | 10 | 5½ |
| Virgin's (Cape) | Patagonia | 10 | 0 | |
| Vlie Passage | Holland | 9 | 0 | |
| Volcano Bay | Jesso Island | 5 | 30 | |
| **W.** | | | | |
| Wallet | Riv. Thames | 11 | 15 | |
| Walwich Bay | Africa | 1 | 54 | 6 |
| Wardhuys | Lapland | 4 | 0 | |
| Warrens Point | Ireland | 11 | 30 | 19 |
| Watchet | Bristol Chan. | 6 | 45 | |
| Waterford H. ent. | Ireland | 5 | 50 | 12 |
| Weems | Scotland | 2 | 0 | |
| Weilings | France | 1 | 30 | |
| Wells | Norfolk | 6 | 0 | |
| Weser R., entr. | Germany | 12 | 0 | |
| Western Brace | Bay of Bengal | 9 | 36 | |
| Western (Port) | New S. Wales | 12 | 30 | 14 |
| Westra | Shetland Isles | 9 | 0 | |
| Wexford Harbour | Ireland | 8 | 0 | 4 |
| Weymouth | England | 6 | 30 | 7 |
| Whampoa | Canton River | 2 | 30 | |
| Whitby | England | 3 | 45 | 13 |
| Whitehaven | England | 11 | 15 | |
| Wick | Scotland | 9 | 15 | |
| Wicklow | Ireland | 9 | 0 | |
| Wilmington | United States | 11 | 0 | |
| Winchelsea | England | 12 | 45 | |
| Windsor | Bay of Fundy | 12 | 0 | 36 |
| Winterton | England | 8 | 15 | 10 |
| Winterton Ridge | North Sea | 7 | 50 | 10 |
| Wisbeach | England | 7 | 30 | |
| Wolf Rock | Eng. Channel | 4 | 30 | |
| Woodbridge Bar | England | 11 | 30 | 14 |
| Woolwich | Riv. Thames | 2 | 15 | 18 |
| Wranger Oog | North Sea | 12 | 0 | |
| Wrath, (Cape) | Scotland | 8 | 15 | |
| **Y.** | | | | |
| Yarmouth Roads | England | 8 | 40 | 8 |
| Yarmouth Sands, (back of) | England | 10 | 30 | |
| Yarmouth | Isle of Wight | 9 | 30 | |
| York, (Fort) | New Wales | 9 | 20 | |
| York, (New) Battery | United States | 8 | 54 | |
| Yorkshire (Coast) | England | 6 | 0 | |
| Youghall, entr. | Ireland | 5 | 0 | 11 |
| **Z.** | | | | |
| Zanzibar | Africa | 4 | 45 | 9 |
| Zuder Zee | Holland | 1 | 30 | |
| Zuric Zee | Holland | 3 | 0 | |

FINIS.